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IMPERIAL BUREAU OF MYCOLOGY
7 JUL 1930

# The Gardens' Bulletin

## STRAITS SETTLEMENTS

Vol. V JUNE 1930 Nos. 3-6

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THE
# GARDENS' BULLETIN
STRAITS SETTLEMENTS

Vol. V.] JUNE, 1930 [Nos 3.–6.

## ON DIOSCOREA GIBBIFLORA, Hook. fil.

A Dioscorea was found by one of us in 1915 on the island of Tiuman in the cut-over jungle about the Malay village of Juara bay. Its stems were unarmed and its leaves as in figure 1 on page 53 forward. In the next year at the foot of the limestone cliffs of Batu Caves, near Kuala Lumpur, a single somewhat similar plant was found, its leaves being as in figure 7, and at the back suffused along the veins with a pink colour. These were regarded as belonging to a species allied to *D. myriantha,* Kunth: and as the Batu Caves locality is close to a railway station, it was visited repeatedly during the next few years in a vain effort to obtain flowers. Leaves were found as in figure 9, which were regarded as characterising a more mature condition than had been found in 1916; but flowers could not be found. In 1921 more sterile material came to hand from Sibolangit in Sumatra, and in 1922 from Negri Sembilan. In 1924 as a result of enquiries for wild roots eaten by the Sakai, the same species was twice met with; firstly in western Pahang under the name of Wauh; and secondly it was sent to us by Father Schebesta from near Baling on the Kedah-Perak boundary as Eoh. It was met with also near Grik, in Upper Perak, and brought into cultivation in the Botanic Gardens, Singapore, for study from this place and from two localities in Pahang.

Cultivation has not supplied flowers, but has supplied material from which the succession of the diverse forms of the leaves can be followed, and has enabled the underground parts to be studied.

The finding of flowers (male) was made in 1927 by Mr. M. R. Henderson near the Pahang-Kelantan boundary. Their structure reminded us of *D. gibbiflora* Hook. fil., and caused us to re-examine very carefully the badly dried material from Penang upon which it was founded—material which George Porter, the Penang schoolmaster, collected in 1825 for Wallich. We conclude that our specimens should bear that name, unless ultimately it be ascertained that *D. gibbiflora* is only well-grown *D. myriantha,* Kunth.

The place we would give to it in our classification is in the series of *D. alata,* Linn., within the section Enantiophyllum. This series is characterised by the combination of four characters (1) stem unarmed almost invariably:

(2) tubers not stalked but swelling gradually from their point of origin downwards, edible, (3) the male flowers on a zigzag axis with sharp flexures and (4) (distinguishing them from the series of *D. opposita* which possesses characters 1—3) these male spikes carried for the most part upon leafless branch-endings. The divergence along the male spikes appears to be 5/12, so that each third flower is nearly superposed and in a dried herbarium specimen, by reason of displacements of the flowers, the primary spiral of the phyllotaxy sometimes seems to pass through three and sometimes through two flowers in each turn. Ridges rise upon the axis and grow higher making angles of which at any place there are three, with three ridges on the faces. Each ridge in its turn, after becoming an angle, is ended by a flower.

The following is a key to the series of *D. alata*, Linn.

Leaves (except those at the very base of a new shoot produced in the sun) widest on a higher level, generally much higher, than the insertion of the petiole:

Blade of the leaf dull when dried, particularly on the upper surface:

The expanded male flower wider than its small flattened base:

Stem peculiarly rough with minute warts; petioles very short; blades narrow, up to 12 cm. long by 2.5 cm. wide, or sometimes to 4 cm.; the auricles very small..... .....1 *brevipetiolata.*

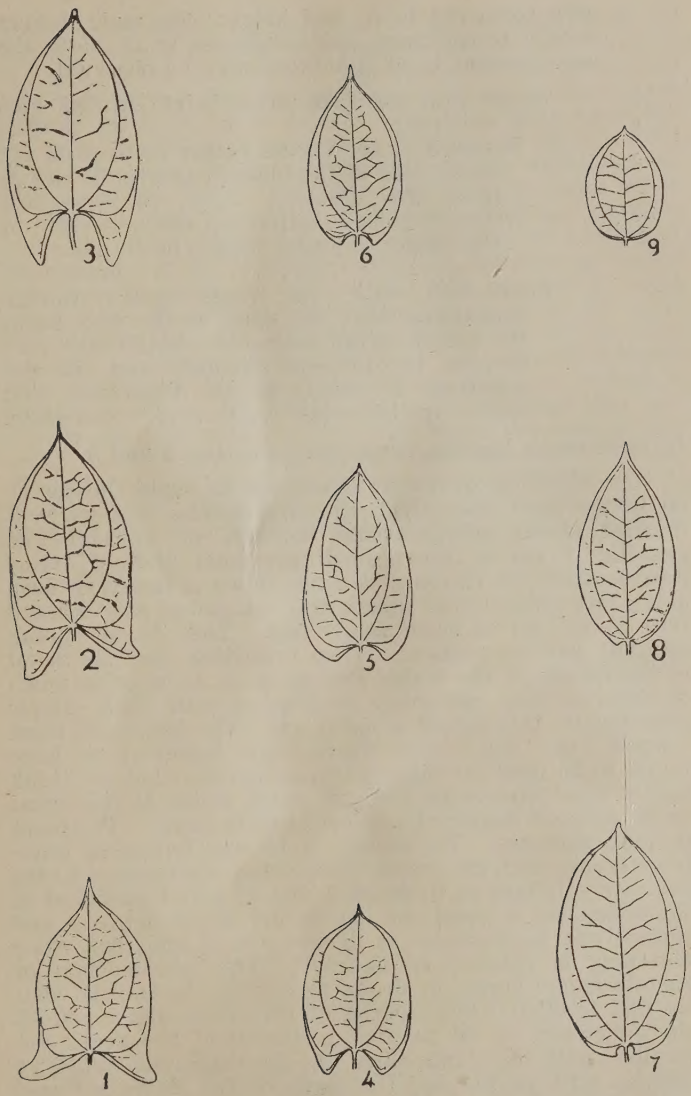
Stem smooth; petioles at least one half as long as the blade which may be 24 cm. long by 7 cm. in width; the auricles large (As the male flowers of this are not yet known, its position rests on an assumption)..... .....2. *kratica.*

Stem smooth; petioles one third to one half as long as the blade, which is ovate with a rectangular sinus.....3. *fordii.*

The expanded male flower not wider than its very broad flattened base which has a peculiar small wart directed upwards and immediately opposite to the bract.....4. *gibbiflora.*

Blade of the leaf when dry dull on the upper surface, but on the lower liver coloured and bright: the leaves shaped like those of *D. gibbiflora,* but smaller and particularly those associated with the flowers; the flowers shaped as those of *D. gibbiflora*.....5. *myriantha.*

Leaves with their widest part about or below the level of the insertion of the petiole, the colour when dry




1 and 2 leaves such as are produced on a shoot exposed to the sun: 3 a transition towards the next: 4 and 5, leaves such as are found upon young plants in shade: 6, a leaf typical of a normal plant in vigorous growth: 7 and 8, leaves transitional towards 9 which is a leaf associated with the production of flowers. All ½ nat. size.

with some red in it, and bright: the male flowers with a broad base, and sometimes in *D. alata* the wart present in *D. gibbiflora* may be observed.

Stems thin and firm, often bright, tinted with a rust red:
Network of the nerves rather distinct on the under side of the blade: capsules in size as those of *D. alata*.....6. *persimilis.*
Network not so distinct on the underside of the blade: capsules larger in *D. alata*.... .....7. *hamiltonii.*
Stems soft, with four wings usually, though sometimes there are more at the very base: the tubers owing to man's selection are very diverse in different strains, and do not penetrate so deeply as the tubers of wild species in the series.....8 *alata.*

*D. raishaensis* Hayata, comes between Nos. 6 and 8.

*D. gibbiflora* grows in forest, not as some Dioscoreas do in the deep loam along the stream-sides, but in well-drained places, often among boulders of limestone or granite. From a rather small perennial knot of tissue representing the rhizome, it sends down a few very deep going soft white-fleshed tubers, which it is said may descend into the soil for as much as five feet. They do not spread laterally but are vertical. They are edible and the Sakai of the forests of the Malay Peninsula eat them or as much of them as they can obtain by digging with their simple implements; this indeed is not much. The Sakai call them "wauh" or "eoh." The word wauh, however, we have found to be used for other yams sometimes: but we think that it must always be used for yams which as the Sakai settle are soon neglected, and confused in name. The plant is quite glabrous. The shoots, if by any felling or other interference with the forest canopy they are exposed to the sun, carry foliage as in figure 1 and 2: but if produced in the shade, as is usual, the leaves are as in figure 4 and successively have shapes as figures 5 to 8, and then when flowering is reached as figure 9. This phenomenon of hastate leaves borne on shoots formed in the sun, is what we find in other forest species of Dioscorea, and is one of the difficulties in the path of a student of the genus unfamiliar with the plants alive. In the shade, the stems are mottled with purple and the backs of the leaves suffused with pink along the veins. Sun-leaves do not exhibit such colours. Bulbils form near to the stem-tips: if simple they are ob-pyriform; but they are commonly compounded. At flowering the first spikes appear in pairs in the uppermost few leaf-axils: then leaf-production and in the axils of

bracts more spikes follow paired or above single until the stem or branch becomes too weak to bear more. Whereas the first leaves on the stems are alternate, the leaves long before flowering time become opposite or almost so. Upon section the spike-axis is seen to be roughly triangular; but on each face is a more or less pronounced ridge. At a flower the angle which bears it ends in the midrib of the bract, and the flower itself sits tight upon the axis which suddenly flattens under it. Right and left of the insertion of the bract the ridges of the two faces get greater strength, the one close to the bracteole more than the other so that it very soon becomes an angle of the axis restored to being triangular. The divergence of the bracts along the spike axis being apparently 5/12, neither the second nor the third flower is exactly superposed, but both near enough to superposition to give here and there along the axis (which is twisted at times) the impression to the eye that they are. The bracts are ovate; and at each bract the axis is bent away from it, an arrangement which together with the disappearance of the angle gives room for the tight-setting of the flower. The bracteole is triangular. The flower-base is very much flattened and on the upper side bears the

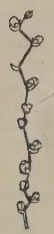


Fig. 10. Male flower-spike, nat. size.

peculiar wart mentioned above and figured in figures 11 and 12. The sepals open very little: they are ovate and rounded above. The petals are similarly shaped but thinner. The stamens are six on short filaments and arranged exactly as in other species of the section Enantiophyllum. There is only a very slight elevation of the centre of the base of the flower to indicate the place for the female sexual organs.

The female flowers are still unknown.

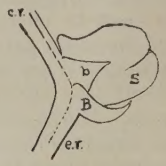



Fig. 11. Male flower enlarged. S, lower sepal. B, bract. b, bracteole. e.r., growing ridge, which becomes an angle of the axis upwards.

Fig. 12. A thick vertical section through a male flower.

The following are the known localities.

**SIAM.** Circle of **Puket.** Under the limestone caves at Pangnga, *Mohamed Haniff and Mohamed Nur.* 3868! (a little doubtful) Circle of **Surat.** Tong Seng, *Mohamed Haniff and Mohamed Nur* 4286! Circle of **Pattani.** Banang, at 300 ft., *Kerr's collector.*

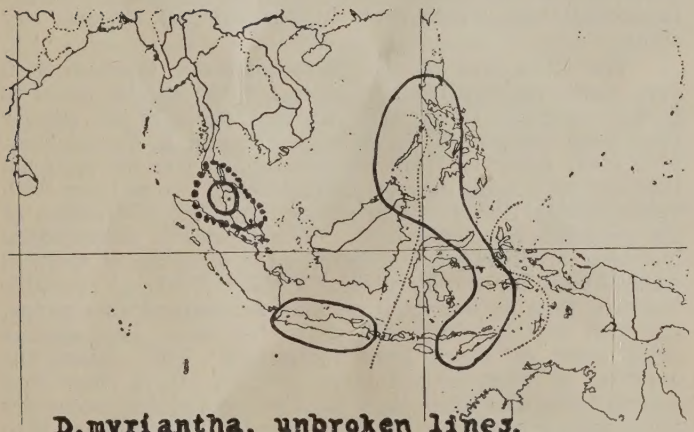
**MALAYA.** State of **Kedah.** Islands of Langkawi, *Curtis,* 2612! Baling, *Schebesta!* Island of **Penang,** without exact locality, *Porter* 5105 B in Herb. Wall.! State of **Kelantan.** Kuala Rek, *Mohamed Haniff and Mohamed Nur* 10188! State of **Pahang.** On Bukit Senai near Chegar Perah, *Henderson* 19418! Raub, *Burkill and Mohamed Haniff* 16765 a! Six miles north of Bentong, *Burkill and Mohamed Haniff* 16709. Pelangai, *Burkill and Mohamed Haniff,* 16787! Island of Tiuman among granite boulders Juara Bay, *Burkill* 989! 1012! and Lubok Lanun at 800 feet, *Mohamed Nur,* 18860! State of **Perak.** Kuala Kendrong near Grik, *Burkill and Mohamed Haniff* 12402! Temengoh, *Schebesta* 14! Padang Rengas, under the limestone cliff, *Burkill and Mohamed Haniff* 12438! State of **Selangor.** Under the limestone cliffs at Batu Caves, Burkill 2269! 4417! 4418! 6340! 6353! 6364! State of the **Negri Sembilan,** Tampin on granite, *Burkill!* Tebong forest reserve, *Holttum* 9622!

**SUMATRA**, Bukit Kramat Kuda near Sibolangit, *Mohamed Nur*, 7266!

The annexed map shows the distribution of *D. gibbiflora* (the dotted line) and *D. myriantha* (the unbroken lines). Formerly we regarded certain eastern Malaysian specimens of *D. myriantha* as *D. gibbiflora*, and published that view in our Synopsis of the the Asiatic Dioscoreas (Journ. As. Soc. Bengal. N. S. 10, 1914, p. 36), but we have transferred them to *D. myriantha*, suspecting however, that the two species may ultimately be united. The occurrence of both together in the Langkawi islands is to be remarked.

D. PRAIN.

I. H. BURKILL.



# THE GENUS LINDSAYA IN THE MALAY PENINSULA.

## With Descriptions of Two New Species.

*By R. E. Holttum.*

The genus Lindsaya as here arranged is represented in the Malay Peninsula by 18 species, two of which are now described as new. A few of them, especially those confined to the mountains, are not yet adequately known, and it is possible that further study in the field will reveal a few more distinct species. In this genus it is not infrequent for plants immature as regards size to bear fertile pinnae; thus, in many species simply pinnate fronds on young plants may be fertile, while more mature plants may bear bipinnate fromds, the leaflets in the two cases being sometimes rather different. It is therefore important, in all cases, to have ample material, in order that the full range of habit of a species may be known. Observation in the field is also essential; most species have a quite definite habitat, especially those which grow by the sides of streams and rivers.

The Lindsayas of the Peninsula have hitherto been very conservatively treated, especially the species allied to *L. decomposita*. In the past, only two species of this affinity have been recognised, *L. decomposita* and *L. davallioides*. It is clear however from examination of copious material that several species may be distinguished, two of them with veins usually free (thus breaking down the distinction of the subgenus *Synaphlebium*). The species *L. decomposita* has been credited with a distribution throughout tropical Asia, Australia, and Polynesia; I think it highly probable however that no one type persists throughout this range, and that further study will show that many local species exist, such as those here recognised. This raises the question of what constitutes a species. It is clear that among ferns all species have not the same status; some are much more comprehensive than others. The tendency is to divide the species more minutely as more material is available for study, and in many groups such subdivision rests on a basis of genuine natural distinction. In other groups, at least in the Malay Peninsula, a clear distinction does not seem possible, even with ample material; an example of this is the group of *Dryopteris crassifolia*. In such cases more intensive field study will doubtless give more information, but I am doubtful whether a final distinction will always be possible by methods of observation alone. It is at least certain that in such groups the description of new species based on isolated herbarium specimens is quite useless.

The species allied to *L. decomposita* seem to be on the whole sufficiently distinct, except for the mountain plant

*L. subalpina*. The other large group of species within the genus, that of *L. scandens, L. pectinata* and *L. repens* is much less clearly resolvable, and I am by no means satisfied with the present arrangement, especially as regards *L. pectinata*.

In the discrimination of closely allied species in this genus, the rhizome scales, which in other genera are often very characteristic, afford little assistance. These scales are of a very uniform nature throughout the genus, differing chiefly in size, in relative width and in depth of colour; the scales of *L. plumula* and *L. scandens*, for example, are quite different, but between closely allied species no distinction can be found.

The Lindsayas are nearly all plants of the full shade of mature forest. The only exceptions to this in the Peninsula are the clearly xerophytic montane species *L. rigida, L. plumula*, and probably the plant here named *L. cultrata* var. *parvula*. No lowland species grow in open sunny places, and all except the climbing forms of *L. scandens* are terrestrial. The following grow beside shady river banks, and appear rarely to be found elsewhere: *L. Lobbiana, L. orbiculata, L. integra*.

I am indebted to the Director of the Botanic Gardens, Buitenzorg, for the loan of numerous specimens from the Buitenzorg herbarium, including the types of several species.

The following key is not altogether satisfactory, as in many cases the distinctions between species, though clear enough to the eye, are not easy to summarise in a short sentence. I believe however that it will serve in most cases, though it may not cover every individual plant.

**A** veins free
  **B** fronds once pinnate
    **C** largest pinnae less than 1 cm. long
      **D** pinnae fan-shaped, sorus continuous along outer edge *L. orbiculata*
      **D** pinnae longer then broad, usually lobed
        **E** pinnae to 4 by 7 mm., horizontal *L. cultrata v. parvula*
        **E** pinnae to 3 by 9 mm., oblique *L. plumula*
    **C** pinnae usually about 1 cm. long
      **F** rhizome short-creeping *L. Lobbiana*
      **F** rhizome long-creeping or climbing
        **G** pinnae broad, decurved, sori continuous, bipinnate fronds on mature plants *L. scandens*
        **G** pinnae not decurved, to 15 mm. long, sori separate or more or less united, no bipinnate fronds *L. pectinata*

G pinnae straight, slightly tapering, to 2.5 cm. long, upper edge lobed
*L. repens*

B fronds bipinnate
H rhizome long-creeping
I pinnules to about 5 by 8 mm., coriaceous, lobed
*L. rigida*
I pinnules to about 7 by 15 mm., thin, entire
*L. scandens*
H rhizome short-creeping
K pinnules entire
L pinnules to about 7 by 15 mm., *L. scandens*
L pinnules about 5 mm. long, pinnae numerous
*L. borneensis*
L pinnules fan-shaped, sorus continuous along outer edge, pinnae few
M the terminal pinnules joined to form a large lobed triangular leaflet *L. tenera v. gigantea*
M the terminal pinnules no so joined
*L. orbiculata*
K pinnules more or less lobed, with several sori
N pinnules much longer than broad
O pinnules close, horizontal, to 4 mm. wide
*L. napaea*
O pinnules to 6 mm. wide at base, oblique, lobed to 1 mm. deep *L. malayensis*
N pinnules hardly longer then broad *L. tenera*
A veins anastomosing
P pinnules entire or slightly lobed
Q fronds usually pinnate
R pinnae ascending, to about 5 by 12 mm.
*L. integra*
R pinnae decurved, to about 6 by 22 mm.
*L. recurvata*
Q fronds usually bipinnate *L. decomposita*
P pinnules distinctly lobed
S lobes half way to lower edge
*L. parallelogramma*
S lobes less than half way to lower edge
T leaflets to about 4 by 12 mm.
*L. davallioides*
T leaflets larger
U leaflets acute, sorus continuous round tip
*L. recurvata*
U leaflets not acute *L. subalpina*

Mr. H. N. Ridley's paper, "The Ferns of the Malay Peninsula," published in the Journal of the Malayan Branch, Royal Asiatic Society, Vol. 4, pp. 1—121, is here referred to as Ridley (1926).

**L. Lobbiana** Hook., Spec. Fil. 1, p. 205, tab. 62 C.

*L. propria* v. A. v. R., Bull. Jard. Bot. Buitenzorg, Ser. 2, XVI, p. 20.

The type of this species came from Java, and in my opinion *L. propria* (of which I have examined authenticated specimens) is quite identical with it. The common Peninsula fern usually referred to it has usually paler stipes, smaller fronds, and pinnae on the whole more broadly truncate at the apex, than the plants from Java, but the distinctions are small and by no means constant. In the Peninsula it is a low country plant, and usually found beside streams. The specimens in the Singapore herbarium are very uniform, except that Md Nur's no. 12008 from Sungei Ketil (Keteh), Kelantan, has long fronds (to 45 cm., including stipe) and some quite entire pinnae with narrowly rounded apices. Christensen has a note on this species in this Bulletin, vol. 4, p. 396.

**L. cultrata** (Willd.) Sw. var. **parvula,** var. nov.

Differs from typical *L. cultrata* in its smaller size (stipes to 4 cm. long, fronds to 10 cm. long and 1.6 cm. broad), thicker texture, and dark brown colour of stipes. Specimens in the Singapore herbarium are as follows: Type: Sumatra, Sibolangit, Md Nur 7297; also two unlocated and unnumbered specimens from the Malay Peninsula, collected by Scortechini.

These specimens agree closely together in their small stature and coriaceous texture. In habit of growth and shape of fronds and of pinnae they agree closely, on a small scale, with *L. cultrata,* a species which in its typical form has never been found in the Malay Peninsula.* It is possible that these specimens are depauperate owing to exposed situations of growth, but of this there is no evidence. I hesitate under the circumstances to assign them to a distinct species, but their uniform appearance makes them worthy of notice, and I therefore refer them provisionally to a variety of the wide-ranging *L. cultrata.* This species appears to be very constant throughout its range; in the Singapore herbarium are specimens from Ceylon, S. India, Assam and Java, all agreeing closely together. I have seen it growing in Java, both on Mt. Gedeh in West Java and on the Tengger Mountains in East Java; in both cases it grew on moist banks in rather exposed situations at about 5,000 ft. or more above sea. Its texture is firm, and in this it differs markedly from the majority of Peninsula species, which are shade plants with thin leaflets. A Ceylon specimen (coll. Bishop Hose) is labelled " sides of brooks in the hills." The next species, which is also closely related, grows beside a mountain stream in rather exposed situations.

*L. cultrata.* Since the above was printed I have found typical plants of this species on mossy rocks by Robinson's Fulls, Cameron's Highlands, at an altitude of about 4500 ft. (No. 23463).

**L. plumula** Ridley, Journ. Mal. Br. R. Asiatic Soc., IV, 22 (1926).

This species is known only from Gunong Tahan, at an altitude of about 5,000 ft., and has been found there by all collectors visiting the mountain. I found it growing in a thick close crust of bryophytes on rocks in the bed of the Teku river, where the stream is bordered on both sides by low forest. It grows well above normal water level and is fully exposed to the midday sun, so that its small tough pinnae are a xerophytic adaptation. The smallest fertile fronds are about the size of *L. bullata* v. A. v. R. from Java, but I think they are distinct. The largest fronds however approach very closely to *L. cultrata*, and I am not sure that a distinction can be maintained. The largest frond of *L. plumula* in the Singapore herbarium is 25 cm. long (inclusive of stipe) and 1 cm. wide, the largest pinna measuring 9 by 3 mm. The specimens are as follows (all from Gunong Tahan at about 5,000 ft.) : Wray & Robinson 5521, Ridley 15997, Haniff & Nur 7956, Holttum 20672.

**L. scandens** Hk., Spec. Fil., I, 205, t. LXIII B.

There is a note on this species in this Bulletin, Vol. 4, p. 64. It is there assumed that *L. lancea* (originally described from Surinam) occurs throughout the tropics. I cannot attempt to decide whether the Asiatic ferns assigned to it are really to be regarded as of the same species as those from the New World; but I am still of the opinion that the terrestrial Malayan ferns hitherto regarded as *L. lancea* are not specifically distinct from the scandent ones which have been called *L. scandens*. It is therefore most convenient at present to retain the name *L. scandens* for all the Malayan ferns concerned.

This is probably the most abundant species in the genus, taking the Peninsula as a whole. It occurs in the lowlands, and on mountains to about 3,000 ft., in moist forest, terrestrial or climbing on trees or rocks; never in exposed places. When terrestrial, the leaflets of young plants are larger, and bipinnate fronds are the rule. When scandent, the fronds are more frequently simply pinnate, and the leaflets on the whole somewhat smaller. It is impossible however to distinguish bipinnate fronds of mature well-grown plants, whether terrestrial or scandent. It is hardly necessary to enumerate the many specimens of this species which have been collected in the Peninsula. I will confine myself to listing those which I think should come under the next two species, which are closely allied to *L. scandens*.

**L. pectinata** Bl., Enum. Pl. Jav., 217.

This species has never been figured. I have seen several specimens from Java, which agree well with descriptions, and among themselves. The specimens from the

Peninsula differ from them chiefly in the much darker rhizome and scales, and also in a greater tendency to fusion of the sori. I think however that they may be regarded as conspecific. The specimen from the Peninsula which is nearest to the Javanese ferns is Henderson's no. 11258 from Fraser's Hill. This has simply pinnate fronds to 40 cm. long and 3 cm. wide; the pinnae to about 16 by 8 mm., of thin texture, drying very dark and slightly wrinkled, their lower edges nearly straight and slightly oblique upwards (decurved a little in the lowest pinnae only), the upper edge either lobed slightly throughout or more usually towards the tip only, the lower sori being all joined together (see fig. 4). Other specimens have the sori all joined as in *L. scandens*, though in other respects they agree with the one described. In still others (chiefly immature plants) the pinnae are decurved as in *L. scandens* but with sepatate sori (*e.g.*, Burkill & Holttum 8452 from Fraser's Hill); these approximate to *L. oblanceolata* v. A. v. R., the type of which I have seen; I would consider it immature, and probably a form of *L. pectinata*. Other specimens approach *L. scandens* so closely that the line of distinction is very hard to draw. It appears that *L. pectinata*, as here considered, is a mountain species, and simply pinnate (though bipinnate forms are known in Java), as distinct from the lowland *L. scandens*, which has typically bipinnate fronds on mature plants. There is however a lowland specimen from Johore which agrees rather with *L. pectinata* than with *L. scandens*. More field study of *L. pectinata* is required before it can be properly understood. It may perhaps be only a mountain form of *L. scandens*. The following is a list of specimens provisionally referred to it. There are also a few unlocated specimens, probably from Perak.

JOHORE: Ulu Kahang, 400 ft., Holttum s.n. (May 1923).

PAHANG: G. Tahan, Ridley 15995; Kluang Terbang, Barnes s.n. (1900); Fraser's Hill, 4,000 ft., Henderson 11258 (F.M.S. Mus. Herb.), Holttum 11369 and s.n. (13.8.23), Burkill & Holttum 8452, E. Smith 839.

PERAK: G. Hijau, 4700 ft., Burkill 12664, Fox s.n. Oct. 1899); Cottage, Taiping Hills, H. D. Hervey s.n. (1889); Bujang Malacca, Ridley 9603.

**L. repens** (Bory) Bedd., F.S. I., t.209.

There are certain specimens, chiefly from Perak, which agree well with this species as described and figured by Beddome. They differ from those referred to *L. pectinata* by their longer pinnae (to 2.5 cm.) their sori always separate, and the upper edges of the pinnae regularly lobed. Immature plants from Maxwell's Hill have their

younger fronds with pinnae lobed almost to the lower edge, as in *L. hymenophylloides* Bl. Typical specimens of *L. repens* are as follows:

PERAK: Taiping Hill, Burkill 12835; Bishop Hose s.n. (Aug. 1884, Herb. Hullett); Maxwell's Hill 4500 ft., Fox 115; Maxwell's Hill 3000 ft., Scortechini s.n. (March 1884).

PAHANG: Telom, Ridley s.n. (Nov. 1908).

Ridley's 8666 from 15th mile Pahang Track has separate sori, but the upper edge only slightly lobed; it is midway between typical *L. repens* and *L. scandens*, and might perhaps be referred to the latter. Finally, there is a specimen from Bukit Timah, Singapore (collected by Ridley in 1893) which agrees quite well with *L. repens*, except that it is small (the largest pinna in 1.6 cm. long). Possibly it is only an abnormal juvenile form of *L. scandens*. It is clear that the group of species *L. repens*, *L. scandens* and *L. pectinata* is a very close one, and further work on their relationships is necessary.

**L. orbiculata** (Lam.) Mett.

Christensen has a note on this species in this Bulletin, Vol. 4, pl 397. Taking the species in his sense, the following specimens are clearly referable to it. They are easily distinguished by the characters he mentions. Like *L. Lobbiana*, this is usually a riverside species, though not exclusively so. The localities from which specimens have been collected are comparatively few, and it is curious that none are from Perak.

SINGAPORE: Changi, Ridley 13341; Pulau Brani, Hullett s.n. These Singapore specimens are large (to 45 cm. long) and frequently bipinnate.

PAHANG: Bentong, Sungei Perting, Burkill 16574; Tahan River, on rocks, Ridley 2151, Holttum 10547, Seimund 479 (Herb. F.M.S. Mus.).

PENANG: Government Hill, on bank by roadside, Holttum 9079; above waterfall, Holttum 10287; Ridley 9226; Richmond Pool, Fox 10666.

KEDAH: Kedah Peak, Ridley s.n. (June 1893); Bukit Wang, Haniff 1203.

**L. tenera** Dry.

Next to *L. scandens*, this is probably the most abundant species in the Peninsula. It is found as a terrestrial fern on hillsides in high forest throughout the Peninsula, from about 1000 to 4000 ft. above sea level, and occasionally at lower altitudes. It has not been found in Johore or Singapore. It is very uniform, and at least in the Peninsula very sharply distinct from *L. orbiculata*, so that it should clearly be separated as a distinct species. There is no need to enumerate the large number of specimens.

Beddome's figure (F.S.I., tab. 24) gives an adequate idea of the species, though the pinnules are often more deeply lobed than is there shown.

**L. tenera** v. **gigantea** (Hk.) Spec. Fil., I, 211, t.LXIII. C.

At a few places ferns have been found agreeing fairly well with this figure of Hooker's, but they are smaller, and the terminal undivided part of the lamina larger in proportion. Whether they should properly be reckoned a variety of *L. tenera* I am not certain. At least they are much nearer to that species than to the true *L. orbiculata*. The specimens in question are all from mountain forests; they are:

PENANG: Government Hill, Hullett s.n. (Dec. 1881); Richmond Pool, C. G. Matthew s.n. (Dec. 1906).

PERAK: Maxwell's Hill, 3900 ft., Burkill 13213.

PAHANG: Fraser's Hill, 4,000 ft., Burkill & Holttum 8762, E. Smith 826.

**L. rigida** J. Sm., Hooker, Spec. Fil. I, t.63A.

The type of this species is Cuming's 397 from Malacca (presumably Mt. Ophir). I have seen no specimens from outside the Malay Peninsula, though van Alderwerelt van Rosenburg gives the distribution as including Celebes, New Guinea and the Philippines. *L. triplosora* v. A. v. R. from Sumatra is closely allied. *L. rigida* is the only Peninsula species with a long creeping slender wiry rhizome. It is exclusively montane, occurring in comparatively exposed places, either creeping among bryophytes along the ground or on tree trunks. Its pinnules are very rigid, and appear adapted to its habitat. The specimens in the Singapore herbarium are from Mt. Ophir, Gunong Tahan, the Taiping Hills, and the Main Range at G. Inas, G. Batu Puteh, G. Bubu and G. Bujang Malacca.

**L. borneensis** Hk., Syn. Fil. 107.

This species has been found in comparatively few localities in the Peninsula. It is a very beautiful fern, dark green, often with a metallic iridescence. I have seen it alive only in the moist shady forest on the ridge of G. Panti in Johore. Though superficially similar to *L. rigida*, it is quite different in habit and also in habitat, and the very numerous smoothly rounded almost imbricating pinnules are very distinctive. Young plants often bear simply pinnate fronds. I have seen the following specimens:

SINGAPORE: Kranji, Ridley 14186; Sungei Buloh, J. S. Goodenough s.n.

JOHORE: G. Panti, 1500 ft., Holttum 15044.

SELANGOR: Kanching woods, Ridley s.n. (Dec. 1920; in Kew Herbarium as *L. rigida*).

PAHANG: Tahan River, Ridley (fide Ridley, not seen).

The following specimens cited by Ridley (1926, p. 23) under *L. rigida* are *L. scandens*:

SINGAPORE: Sungei Jurong, Ridley 12132.

PERAK: Taiping Hills, Ridley 3962.

**L. napaea** v. A. v. R., Bull. Jard. Bot. Buitenzorg, Ser. 2, XX, p. 19, t. III.

This species is clearly allied to *L. decomposita,* which it resembles in habit, but it has always free veins, and narrow pinnules very closely placed. It is one of the most clearly defined of what is evidently a group of species of the *L. decomposita* alliance. It was originally described from Lingga, but is found throughout the Peninsula as far north as Kedah, and is very uniform throughout. It is terrestrial, and occurs in forest on hillsides in the same situations as *L. tenera,* usually from about 1000 ft. upwards. The following specimens are in the Singapore herbarium:

MALACCA: Mt Ophir, Ridley 3351.

NEGRI SEMBILAN: G. Angsi, Ridley s.n. (Feb. 1904).

PAHANG: Fraser's Hill, 4000 ft., Henderson 11272 (Herb. F.M.S. Mus.), E. Smith 852, Burkill & Holttum 8466, Holttum 10520; G. Tahan 3000 ft., Holttum 20933.

KELANTAN: foot of G. Sitong, Md Nur 12177.

PERAK: G. Batu Puteh, 3000-4000 ft. Kunstler 8044.

PENANG: Government Hill, 2,400 ft., Fox 58.

KEDAH: Kedah Peak, Ridley s.n. (June 1893).

**L. decomposita** Willd.

Here I place a few specimens which agree closely among themselves, though I am not certain that they are identical with this species. They are rather sparingly bipinnate. A pinnule of the Bukit Timah plant is figured. They appear to be terrestrial ferns of lowland forest. One or two of the specimens approach *L. recurvata,* though the larger ones are quite distinct; further field investigation of the two species is necessary. The specimens are:

SINGAPORE: Bukit Timah, Ridley s.n. (1894).

JOHORE: G. Panti 1600 ft., Holttum 18099; G. Lambak 1500 ft., Holttum 9383.

NEGRI SEMBILAN: G. Tampin 1800 ft., Holttum 9606.

**L. recurvata** Wall. Hook., Spec. Fil. I, p. 222, tab.LXX A.

*L. trapezoidea* Copeland, Univ. Cal. Publ. Bot., 14, no. 17, p. 376, pl. 61 (1929).

Hooker's figure gives a good idea of this species; there is however considerable variation in the shape of the pinnae, and some plants show a tendency to a bipinnate

condition, though this is not usually marked. The sterile pinnae are usually more or less incised along the upper edge. The pinnae of fertile fronds may be almost entire, as indicated in Hooker's figure, and either rounded or decidedly acute at the apex, or they may be distinctly lobed, all conditions sometimes being found on pinnae of the same frond. Copeland's *L. trapezoidea* from Sumatra is identical with some of the Peninsula specimens referred here.

This appears to be a lowland forest fern, and has been found chiefly in the south of the Peninsula, though two Penang specimens are quite similar, and it is likely that more collecting will reveal a wider distribution. The type is apparently a specimen of Wallich's from Singapore. There is one mountain specimen from Fraser's Hill, which has two large lateral branches and some pinnules unusually lobed, but otherwise is typical. Specimens referred to this species are:

SINGAPORE: Bukit Timah, Ridley 9561.

MALACCA: Cuming 392; Hervey s.n. (1889); S. Udang Reserve, Derry 85.

NEGRI SEMBILAN: Senaling-Inas F.R., Holttum 9748; G. Tampin, Holttum 9611.

SELANGOR: Rantau Panjang F. R., Hume 7630 (Herb. F.M.S. Mus.).

PAHANG: near Fraser's Hill, 3700 ft., Holttum s.n. (14.9.23).

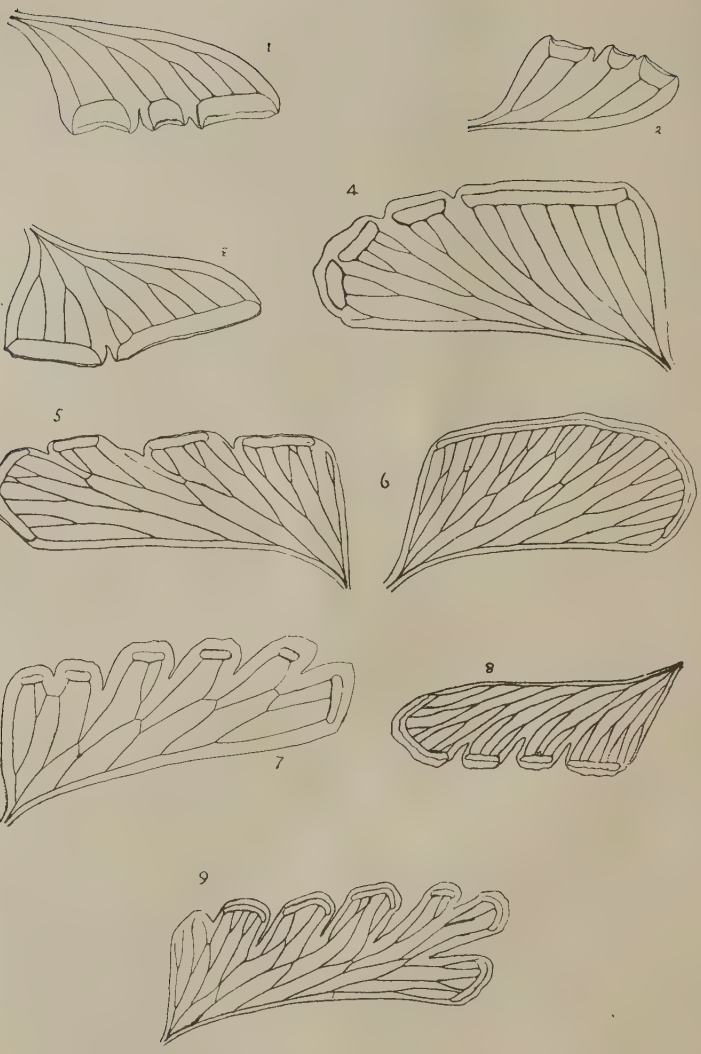
PENANG: Ridley s.n.; Western Hill, Haniff 9120.

In the Buitenzorg Herbarium is also the following:

P. LINGGA, G. Daik, Bünnemayer 6734 a. Copeland's *L. trapezoidea* extends the distribution of the species also to Sumatra.

**L. integra**, sp. nov.; habitus L. Lobbianae, ab illa pinnis integris apicem versus leviter angustatis, venis anastomosantibus, frondibus interdum ramosis, differt.

Rhizome short-creeping, the younger parts covered with small narrow scales. Stipes 5 mm. apart, 3–12 cm. long, four-angled in their upper part, pale or occasionally brown in the largest fronds. Fronds usually once pinnate, 7–20 cm. long, to 2.5 cm. wide. Pinnae glabrous, almost touching, more distant and somewhat reduced at the base, and smaller towards the apex of the frond, sessile, 8–15 mm. long, 3–5 mm. broad, the lower edge straight, ascending, the base rather narrowly cuneate, the upper side usually entire, the apex broadly rounded; texture chartaceous, drying rather pale green. Veins anastomosing irregularly, visible on both surfaces, but not prominent. Sori continuous (occasionally interrupted) from upper




Figs. 1 and 2. L. plumula.
Fig. 3. L. cultrata var. parvula.
Fig. 4. L. pectinata (Fraser's Hill, Henderson 11258).
Fig. 5. L. decomposita (Bukit Timah Ridley).
Fig. 6. L. integra (Tahan River, Holttum 20934).
Fig. 7. L. davallioides (Sungei Jeriau, Holttum 21580).
Fif. 8. L. malayensis (G. Kerbau, Haniff 4032).
Fig. 9. L. parallelogramma (Sungei Pelepah, Md Nur 20035).
All magnified about four times.

base round apex of pinnae. Indusium firm, usually rather narrow. Some fronds bear one or two small lateral branches.

TYPE: Tahan River, Holttum 20934, on rocks by river bank.

This appears to be an exclusively riverside species. It has the habit of *L. Lobbiana*, but the pinnae are nearly always quite entire, and the veins anastomose irregularly. Its relationship is apparently with *L. recurvata*. Other specimens are:

PAHANG: Tahan River, Ridley s.n. (1891); K. Teku, Seimund 422, 595 (Herb. F.M.S. Mus.).

PERAK: Upper Perak, on rocks in river, 300 ft., Wray 3674; Bujang Malacca, Ridley 9605.

SELANGOR: Rawang, Ridley s.n. (May 1896).

In the Buitenzorg Herbarium is a specimen from Sumatra (Solo tabeantoe, Dr. Burck, 1893).

**L. davallioides** Bl., Enum. Pl. Jav. 218.

I have examined a number of specimens of this from Java, where it appears to be a very uniform species. It has thin translucent pinnules and the venation rather open, though regularly anastomosing. It would appear to grow in very moist places, and Raciborski says of it "an den schattigsten stellen (in der Gesellschaft der grossen Trichomanes-arten und *Treubia insignis*) wachsend." The Peninsula specimens which approach it most nearly are some small plants found growing abundantly by stream-sides below Fraser's Hill, on both sides of the Main Range (in the Tras valley, 3800 ft., Holttum 11492; by the Sungei Jeriau, 3500 ft. Holttum 21580). None of the plants from these collections had fronds with more than one pair of lateral branches, and many of them (already fertile) were simply pinnate. I consider however that in spite of their small size they should be referred to *L. davallioides*. The only other specimens referable here are the following; they have rather larger leaflets, thicker in texture, than the Java plants.

PERAK: Larut Range, 4000 ft., Scortechini 230:437a.

JOHORE: G. Pulai, Ridley 12131.

**L. malayensis**, sp. nov.; ab L. davallioide venis raro anastomosantibus, pinnulis majoribus, ramis paucioribus differt.

Rhizome short creeping; stipes approximate, glabrous, pale. four angled above, to 25 cm. long. Fronds bipinnate, with one or two pairs of pinnae standing at about an angle of 45° to the rachis (on young plants simply pinnate fronds may bear sori). Lateral pinnae to 17 cm. long and 2.5 cm. wide; terminal pinna to 20 cm. long and 3 cm. wide,

narrowed gradually to apex. Leaflets glabrous, thinly chartaceous, horizontal, or slightly ascending, 12 to 15 mm. long, 5–6 mm. wide near base, narrowed slightly towards apex; lower edge straight, slightly upcurved towards the apex; upper edge lobed with 4 to 6 lobes; lobes oblique, about 1 mm. deep; apex rounded. Smaller pinnules with upper edge entire. Veins free or occasionally anastomosing, prominent on the upper surface when dry, visible but not prominent on the lower surface. Sori in the lobes, usually uniting the apices of several veins; indusia firm, rather narrow, the edge undulate.

PERAK: G. Kerbau, 4500 ft., Haniff 4032 (type); Maxwell's Hill 3000 ft., Wray 115.

PAHANG: G. Berumban, Ridley 13945; Cameron's Highlands, 4500 ft., Henderson 11970; Fraser's Hill, 4000 ft., Burkill and Holttum 8707, Holttum s.n. (15.9.23, immature).

This species is clearly allied to *L. davallioides*, but appears to be less hygrophytic in character, and the veins are usually free. As with other mountain speices, further field study is needed.

**L. parallelogramma** v. A. v. R., Bull. Jard. Bot. Buitenzorg, Ser. 3, Vol. 5, p. 212 (1922).

This bipinnate species allied to *L. davallioides* was originally described from the Lingga archipelago. By comparison of Peninsula specimens with the type it appears that *L. parallelogramma* is a very constant species, and that it occurs as a terrestrial fern in lowland forest in many parts of the Malay Peninsula. The pinnules are more deeply lobed than in any other species of this group, and are of very regular shape; the uniform width and the broad but deeply cleft distal ends of the pinnules are characteristic. Both pinnules and lateral branches are nearly at right angles to the main rachis. The specimens in the Singapore herbarium are:

SINGAPORE: Bukit Timah, Ridley 9562, and s.n. (1890); Hullett s.n. (March 1882).

JOHORE: Sungei Pelepah, Md Nur 20035 (figured); G. Berhidong 1500 ft. Holttum 10957.

MALACCA: Lower woods of Mt Ophir, Ridley 3348.

NEGRI SEMBILAN: Bukit Tangga, Md Nur 11820; G. Angsi, Holttum s.n. (2.12.22).

PAHANG: Sungei Teku, Seimund 231 (Herb. F.M.S. Mus.); Sungei Tahan Ridley 2179.

TRENGGANU: Bundi, Rostados s.n. (Feb. 1904).

PENANG: Government Hill, Hullett s.n. (Dec. 1881); Ridley s.n. (Dec. 1895).

In the Buitenzorg herbarium is also the following:

SUMATRA: Djambi, 160 m., Posthumus 600.

**L. subalpina** v. A. v. R., Bull. Jard. Bot. Buitenzorg, Ser. 2, XXIII, 15 (1916).

This species is a relatively large simply pinnate fern with regularly lobed pinnae and anastomosing veins, allied to *L. davallioides,* but the leaflets much larger. There are two specimens from the Main Range in the Malay Peninsula which agree fairly well with the type of this Sumatran species, though they have rather smaller, often less regularly lobed, leaflets, and one has branched fronds. They are certainly distinct from the specimens referred to *L. davallioides,* and I provisionally refer them here, though it is possible that further collecting will indicate a distinction from the Sumatran species. This may be a case in which the mature plant is bipinnate, and it may be that the present simply pinnate collections are an immature state, not typical of the species. It is not safe in such a case to found a new species without ample material.

PAHANG: Fraser's Hill, 4000 ft., Holttum 11340.

PERAK: G. Kerbau, 4500 ft., Haniff 4023.

## EXCLUDED SPECIES.

*Lindsaya gracilis* Bl.

I have seen several specimens of this species from Java. All agree closely together in having a long dark shining slender wiry rhizome, and narrow, rather deeply lobed, very oblique pinnae. So far as I know, nothing like these specimens has been found in the Peninsula. Ridley (1926, p. 22) refers a specimen from Bukit Tangga, Negri Sembilan, to *L. gracilis.* This specimen is at Kew, where I examined it, and noted that it appeared to be similar to the plants here referred to *L. Lobbiana.*

*L. concinna* J. Sm.

The type of this species (figured by Hooker, Spec. Fil., I, t.LXI B) is from the Philippines, and is quite distinct from any plants I have seen from the Peninsula. The specimens assigned by Ridley (1926), p. 21) to *L. concinna* are small simply pinnate forms of *L. orbiculata.*

## NEW SPECIES FROM THE MALAY PENINSULA.

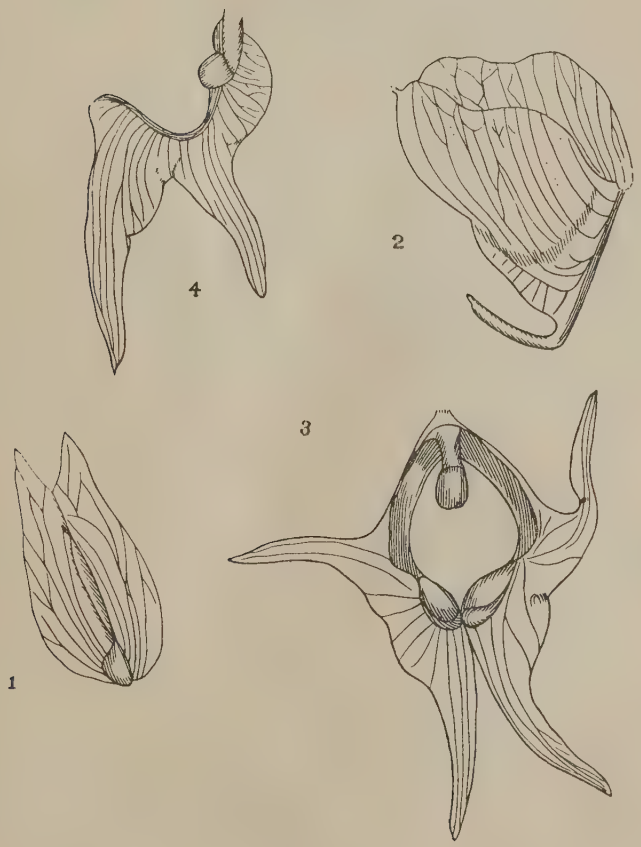
### BALSAMINACEÆ.

**Impatiens tipusensis,** *Henderson, sp. nov.*

Herba reptans succulenta, glabra, caule basi ramoso, ramulis carnosis. Folia alterna, exsiccata membranacea, glabra, triangulo-ovata, acuta, crenata setulis interjectis, basi truncata vel leviter cordata, ad 8 cm. longa, 6 cm. lata, nervis utrinque circa 6, gracillimis, petiolis carnosis ad 9 cm. longis, apice biglandulosis. Pedicelli solitarii, 5·5 cm. longi, bracteati. Sepala 4: 2 exteriora ovata-rotundata, 1·2 cm. longa, 1 cm. lata; 2 interiora oblonga, 4 mm. longa, circa 1 mm. lata. Vexillum oblongum, apice bilobum, circa 2·3 cm. longum. Alae stipitatae, 3·5–4 cm. longae; lobus distalis triangulo-acutus, falcatus, geniculatus; lobus basalis similis, brevior. Labelli limbus late infundibuliformis, 4·2 cm. longus, ore 2 cm. diam., mucronato; calcar 1 cm. longum, incurvum. Filamentia linearia, circa 5 mm. longa. Antherae in capitulum oblongum circa 3 mm. longum connate. Ovarium fusiforme, acutum, 3 mm. longum.

A succulent creeping glabrous herb, stems thick, fleshy, branched. Petioles stout, fleshy, reddish, up to 9 cm. long. Leaves glabrous, shining green above, pale below, alternate, triangular ovate acute, base truncate or shallowly cordate, edge crenate with small teeth in the notches, two glands close to the insertion of the petiole, nerves about 6 pairs, fine; up to 8 cm. long and 6 cm. broad. Flowers solitary, axillary, Pedicel pale green with reddish markings, 5·5 cm. long. Bract oblong acute 4–5 mm. long. Sepals 4, the two exterior ones ovate rotund, slightly inaequilateral, concave, with a short blunt process at the tip, 1·2 cm. long and 1 cm. broad, green; the two interior oblong, rounded at tip, green, 4 mm. long and about 1 mm. broad. Vexillum oblong, tip notched, lobes triangular acute, the sinus rather wide, about 2·3 cm. long and 1 cm. broad, slightly keeled, with a blunt green spur at the base, in colour orange yellow with reddish markings at the base exteriorly, paler with a few reddish markings at the base interiorly. Wings stipitate, 3·5–4 cm. long, distal lobes triangular acute falcate geniculate, basal lobe similar but smaller, orange yellow with reddish and purplish markings at the base. Labellum broadly infundibuliform, orange yellow with bold purple-red veinings inside, 4·2 cm. long, 2 cm. across the mouth, the mouth with a small mucro. Spur rather slender, upcurved, 1 cm. long. Filaments slender, linear, about 5 mm. long. Anthers connate in an oblong head about 3 mm. long. Ovary fusiform acute, 5 mm. long.

PAHANG; Gua Tipus, near Chegar Perah, growing in great profusion on limestone rocks, Henderson 19399 (type), October, 1927. Living plants were brought to the Botanic Gardens, Singapore, and flowered there.



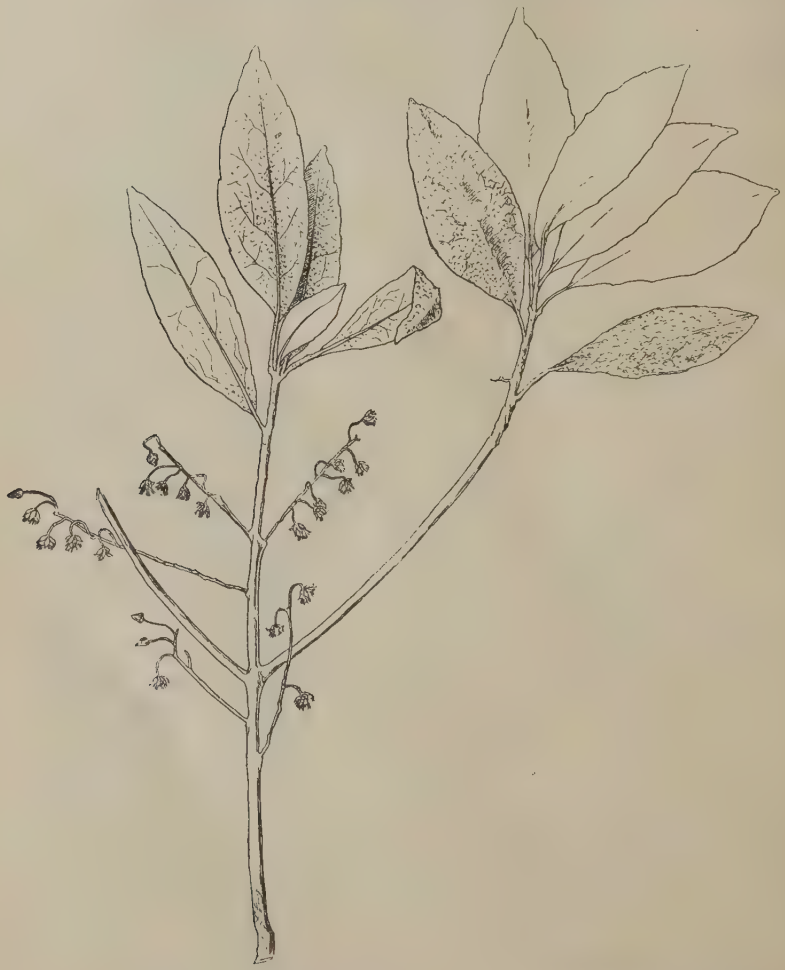

Impatiens tipusensis, Hend.

1. Vexillum. 2. Labellum. 3. Wings from front. 4. One wing spread out. All enlarged.

## ELAEOCARPACEÆ.

**Elaeocarpus tahanensis,** *Henderson, sp. nov.*

Arbor parva, partibus junioribus, racemis, sepalis, exceptis glabra. Folia glabra, elliptico-lanceolata, anguste ovata, vel oblanceolata, apice et basi acuta, nervis utrinque 6, obscuris, ad 9 cm. longa, 3.5 cm. lata. Racemi e axillis defoliatis, ad 6 cm. longi, pedicellis circiter 1 cm. longis. Flori 5-meri, sepalis triangulo-lanceolatis, extus minute pubescentibus, 6 mm. longis, petalis obcuneatis, glabris, circiter 7 mm. longis, vix ad medium fissis, laciniis 14 vel 15; ovario 3-loculare.



Elaeocarpus tahanensis, Hend. x ½. Del. J. R. Charton.

Gardens Bulletin, S.S.

A small tree, glabrous except for the buds, inflorescence and sepals, branchlets reddish brown, stipules very caducous. Leaves glabrous, crowded towards the ends of the branches, elliptic lanceolate or narrowly ovate or oblanceolate, narrowed to the base, apex acute, thick and leathery when fresh, coriaceous when dry, margin thickened recurved, faintly crenate with minute black teeth, lower surface black dotted, up to 9 cms. long and 3.5 cms. broad. Nerves almost invisible when fresh, obscure when dry,

1

2

3

4

Elaeocarpus tahanensis, Hend.
1. Sepal x 7. 2. Petal x 8. 3. Stamen x 12.
4. Ovary, style and torus x 6.

about 6 pairs, interarching far from the edge. Petioles up to 1.7 cms. long, flattened above. Racemes from axils of fallen leaves, up to 6 cm. long, rachis minutely pubescent.

Pedicels nodding, about 1 cm. long, minutely pubescent, especially near apex. Sepals 5, minutely pubescent, especially near base, triangular lanceolate acute, base broad, edge thickened, midrib strongly marked, almost a keel, 6 mm. long. Petals 5, obcuneate, 7 mm. long with 14 or 15 narrow laciniae about 3 mm. long, glabrous, veins conspicuous, the base thickened. Stamens about 27, filaments about 1.5 mm. long. Anthers oblong quadrangular, about 2 mm. long, finely pubescent, divaricate at tip, one slightly longer than the other, both with a tuft of short bristles at their tips. Torus of 5 rounded deeply wrinkled pubescent lobes. Ovary ovoid conic, 3-celled, 6-ridged, densely pubescent. Style 4 mm. long, narrowly cylindric conic, pubescent below, glabrous above, grooved and twisted.

PAHANG, Gunong Tahan, 3500–4500 ft., Holttum 20630 (type), August 1928. A small tree in ridge forest, flowers white.

The young shoots, petioles, leaves, racemes, sepals and petals are covered with irregular white pustulations, caused by aggregations of crystals in the cells of the tissues. This is very evident in dried specimens, less so in leaves and flowers softened by boiling.

## CUPULIFERÆ.

**Pasania Macphailii,** *Henderson, sp. nov.*

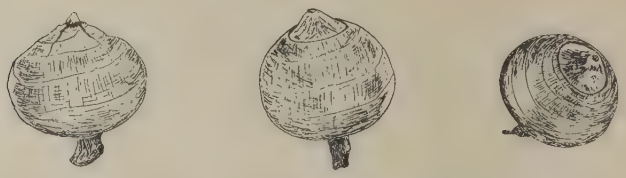
*P. encleisacarpae,* Gamble affinis, fructu minore, foliis majoribus, apice acute acuminatis differt.

A stout spreading much branched tree of medium size, bark brownish grey, finely fissured longitudinally, transversely wrinkled. Branchlets smooth, furrowed, black or dark brown with a minute close grey mealy pubescence. Leaves elliptic oblong, rounded or slightly narrowed at the base, apex caudate acuminate, the acumen acute, both surfaces greyish white when dry, or the upper brownish, up to 22 cm. long and 9 cm. broad, midrib channelled above, elevate below, main nerves about 14 pairs, conspicuous below, curving along margin and looping near apex, rather faint above; transverse nervules and areolate reticulation visible on upper surface, transverse nervules fine but conspicuous below, reticulation not so evident. Petiole stout, 1 cm. long.

♀ spikes 20 cm. long, angled, grey-white pubescent. Flowers solitary on stout flattened upcurved pedicels, bracteoles 1-1.5 cm. long, lanceolate acute. Perianth lobes 6, about 0.5 mm. long, broadly triangular ovate blunt. Fruits conic, up to 2 cm. broad and as much high, the base

Pasania Macphailii, Hend. x 2/5. Del. J. Charton.

narrowed into the thickened pedicel. Cupule free from acorn, thin, smooth, pale grey brown, enclosing the whole acorn except the umbo, with 4 or 5 fairly distinct horizon-



Fruits of Pasania Macphailii, Hend. About natural size.

tal wavy rings, connected by very obscure vertical striae. Acorn covered with pale reddish brown silky pubescence. ♂ spikes unknown.

KELANTAN, banks of Sungai Keteh near Gua Ninik, Henderson 19621 (type), October 1927.

Named after Mr. M. M. Macphail of the F.M.S. Railway Construction Department, to whom I am indebted for much help and hospitality.

## APOCYNACEÆ.

**Kopsia alba**, *Ridl., MSS., sp. nov.*

Frutex glaber, ramulis striatis. Folia brevi-petiolata, opposita, elliptica vel elliptico-obovata, apice caudato-acuminata, basi acuta, nervis lateralibus subtus prominentibus, margine arcuato-anastomosantibus. Cymae axilles vel terminales; bracteae ovato-oblongae. Calycis tubus brevis; lobi 5, late ovato-oblongi, obtusi. Corollae tubus 4.5 cm. longus, apice dilatatus; lobi ovati, albi.

A glabrous shrub 3-5 metres tall. Branchlets pale-brown, ridged. Leaves opposite, elliptic or elliptic-obovate, apex bluntly caudate acuminate, narrowed to the base, 8-18 cm. long, 3-7 cm. broad; main nerves up to 16 pairs, prominent beneath, meeting in a looped intra-marginal nerve close to the edge; reticulations distinct; petiole short, 3-4 mm. long. Cymes terminal or lateral, almost sessile, with one or two branches lengthening to 5 cm., densely covered with small ovate-oblong bracts ciliate on the edge. Calyx tube short, lobes 5, broadly ovate-oblong, blunt, ciliate on the edge, 2.5 mm. long. Corolla tube 4.5 cm. long, dilated near top, mouth of tube densely hairy; lobes ovate, 3-3.5 cm. long, pure white. Anthers lanceolate-acute, base rounded, filaments broad, long hairy. Carpels two, oblong-obtuse, hairy, 1 mm. long. Disc glands 1 mm. long, lanceolate, flattened.

P. TIOMAN, Ridley, s.n. August 1889; Ayer Surin, 800–1000 ft., common in rocky jungle where there is little undergrowth, Henderson 18948 (type).

KELANTAN, Kuala Krai, Haniff and Nur 10093, Jan. 1923; Sungai Keteh, Nur (with Dr. Foxworthy) 11992, Feb. 1924; base of the limestone cliff Gua Panjang at Gua Ninik, Henderson 19496, Oct. 1927.

This species was first collected by Ridley on Pulau Tioman in 1889 and recognised by him as new, but never described. It resembles K. Ridleyana, *King and Gamble*, but differs in being a much larger shrub with larger flowers, the corolla tube dilate near the apex instead of in the middle.

## GESNERACEÆ.

**Paraboea densifolia,** *Hend., comb. nov.* Didymocarpus densifolia, *Ridl. Journ. As. Soc. Str. Br. 44, p. 51; Flor. Mal. Pen. II, p. 521.* P. TIOMAN, Gunong Kajang c. 2000 ft., Henderson 18917. Hitherto known only from Gunong Janeng, Johore, and described by Ridley under *Didymocarpus* in the absence of corollas.

The following is a description of the corolla:—

Corolla campanulate, 1.5–1.7 cm. long, lobes broad, rounded. Filaments broad, short, anthers connivent. Ovary viscid hairy. Style long, stigma capitate, rather large.

## ORCHIDACEÆ.

**Oberonia tiomanensis,** *Henderson, sp. nov.*

Herba epiphytica, acaulis. Folia falcata ad 3.5 cm. longa. Racemus ad 10 cm. longus, arcuato-flexuosus. Bractae inflorescentiae triangulo-ovatae, aristatae, 2 mm. longae. Flores 1.5 mm. latae. Sepala ovata, obtusa, concava, 0.6 mm. longa. Petala oblonga, acuta. Labellum trilobatum, 1 mm. longum, lobi laterales linearii, lobus medius oblongus, bifurcatus, divisionibus lanceolatis acutis. Capsula breviter pedicellata, oblonga, 3 mm. longa.

A small epiphytic tufted stemless plant. Leaves falcate, up to 3.5 cm. long. Spike up to 10 cm. long, flowers rather distant. Bracts triangular ovate aristate, 2 mm. long. Flowers 1.5 mm. across. Sepals ovate, blunt, concave, 0.6 mm. long. Petals oblong acute, shorter and narrower than the sepals. Lip 3-lobed, 1 mm. long, side lobes linear, midlobe oblong, deeply bifurcate, the divisions spreading, lanceolate acute. Column short, broad. Capsule shortly pedicelled, oblong, 3 mm. long.

P. TIOMAN, base of Gunong Kajang, c. 2000 ft., Henderson 18919 (type). Flowers and spike coral red.

**Coelogyne tiomanensis**, *Henderson, sp. nov.*

Pseudobulbus ovoideus, sulcatus, monophyllus, 3–4 cm. longus. Folium lanceolatum, acutum, 15–18 cm. longum. Petiolus 4–5 cm. longus. Racemus 6–8 cm. longus, biflorus. Bracteae lanceolatae, acutae, 1.5 cm. longae, deciduae. Sepalum dorsale oblongo-lanceolatum, acutum, carinatum, 4 cm. longum. Sepala lateralia 3.5 cm. longa. Petala anguste linearia oblonga, circa 4 cm. longa. Labellum trilobatum, lobi laterales oblongo-semicordati, erecti, antice rotundati; lobus medius triangulo-ovatus, mucronatus, apice margineque reflexus; carinae duae. Gynostemium lobis lateralibus labelli aequilongum, cucullatum.

Pseudobulbs ovoid, strongly 4-ridged, 3–4 cm. long, leaf one. Raceme from the side of the pseudobulb in axil of leaf, 6–8 cm. long. Flowers two. Leaves lanceolate acute, 15–18 cm. long, petiole 4–5 cm. long. Bracts lanceolate acute, caducous, 1.5 cm. long. Upper sepal oblong lanceolate acute, keeled, 4 cms. long. Lateral sepals narrower, slightly falcate 3.5 cm. long. Petals narrow linear oblong, 4 cm. long, or nearly. Sidelobes of lip large erect oblong, semicordate, rounded, blunt; midlobe triangular-ovate, notched, mucronate, edges and tip recurved, 1.6 cm. long and broad. Keels two, strongly marked, undulate, extending half-way down midlobe and ending abruptly. Column as long as sidelobes of lip, the hood large, ovate blunt.

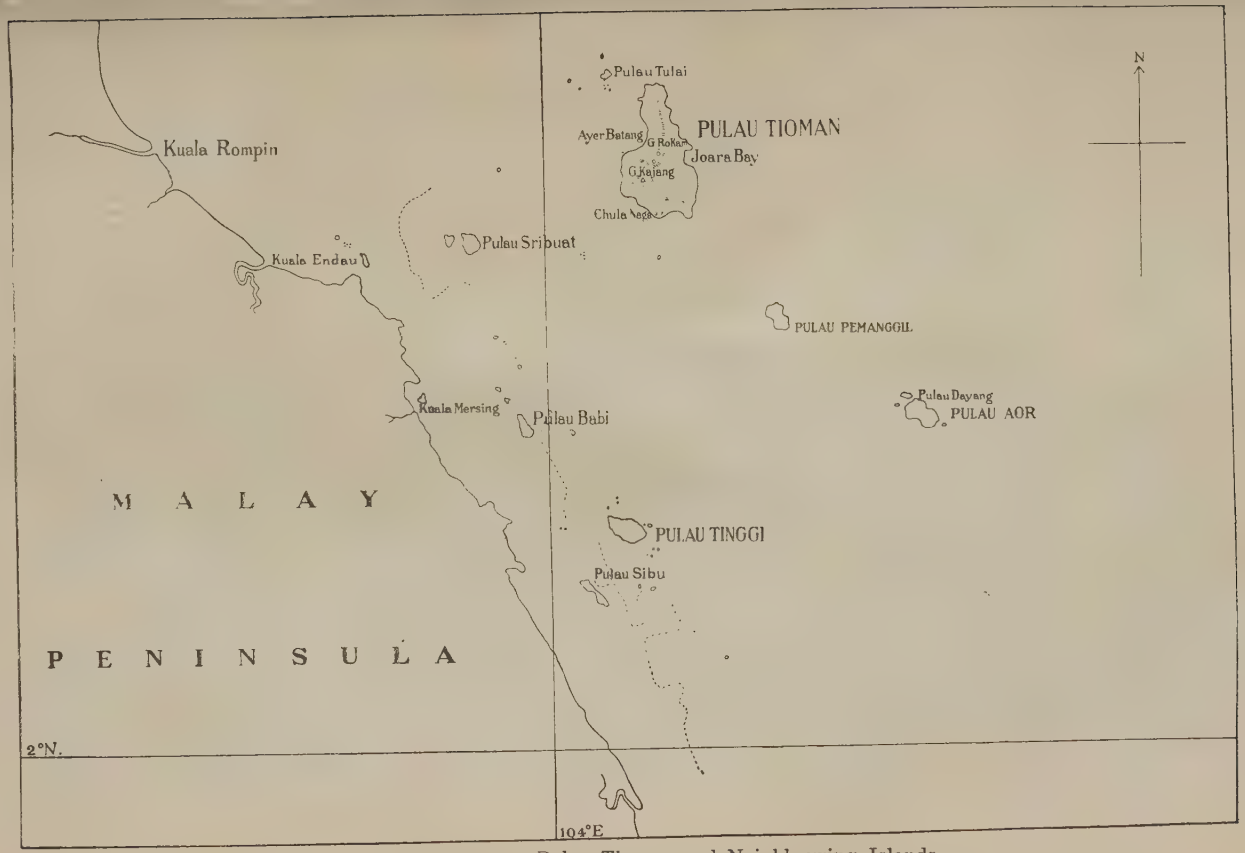
P. TIOMAN, summit of Gunong Kajang, 3383 ft., Henderson 18263; summit of Gunong Rokam, c. 3000 ft., Henderson 18397 (type). Live specimens were brought to Singapore and flowered in the Botanic Gardens.

The sepals are of a very pale flesh colour with yellow midrib; the petals greenish or pale flesh colour; the sidelobes of the lip white veined with brown; midlobe of the lip dark brown in the centre, the keels also dark brown shading to light brown at the edges; the column greenish with two faint brown streaks below; the hood reddish brown.

## NOTES ON THE FLORA OF PULAU TIOMAN AND NEIGHBOURING ISLANDS.

By M. R. Henderson, F.L.S.

Pulau Tioman and its neighbours have been but little explored from a botanical point of view. Up till the time of the writer's visit, collections had not been made above the thousand foot contour.




Pulau Tioman and Neighbouring Islands.

Of the group of islands off the east coast of Johore and Pahang, shown in the accompanying sketch map, collections of plants have been made only on Pulau Tioman and Pulau Tulai, Pulau Tinggi, Pulau Aor and Pulau Dayang. The most interesting is Pulau Tioman, because of its greater elevation above sea-level, and its greater area of untouched forest.

All these islands lie in shallow water, and their flora, as one would expect, is typically Malay Peninsular. Seven plants, however, have, up to the present, not been reported from the Peninsula. All of these, with one exception, are known from Borneo. A list of them is given later.

The writer, accompanied by Mr. N. Smedley of Raffles Museum, Singapore, and a party of collectors, spent the period between April 24th and May 29th, 1927, on Pulau Aor, Pulau Dayang and Pulau Tioman.

## PULAU AOR.

The first week was spent on Pulau Aor and collecting was done up to an altitude of about 1000 feet from the village at Telok Berhala on the north side of the island.

At the time of our visit the population of Aor was said to be about 400, including a few families who lived on Pulau Dayang, the principal occupations being the cultivation of coconuts, and fishing. The population was at one time more considerable than it is now, for the island in past days was a haunt of pirates.

J. T. Thomson, a Government surveyor, visited it in July, 1849, and described it in Logan's Journal, Vol. IV. He gives the dimensions of the island as three miles by one and a half miles, and the height of its two peaks as 1521 and 1805 feet, and says that it contained 1,400 inhabitants.

That the island had a much more extensive cultivation some seventy or eighty years ago than it has today is clearly shown by the following extracts from Thomson's description.

"The bays are fringed with tall cocoanuts of most luxuriant growth, and the trees do not seem to be restricted to the deeper soils for we found many existing amongst rocks and stones where little or no soil was perceptible. The tree is cultivated to the height of 1,000 feet above the level of the sea at which height, I was informed, they were sufficiently productive to repay the expense of their culture. The formation of the island is granitic and the soil is red, nor has it the appearance of being fertile otherwise than in the production of cocoanuts." "The inhabitants possess fine fruit groves amongst which the durian and mangosteen abound."

"It produces 70,000 cocoanuts and 5,000 gantangs of oil, which form its principal exports."

"The inhabitants of Pulo Aur are composed of free men and slaves. In former years the island formed a mart for the sale of captured men and prows, and was frequently visited by the Lanuns once so formidable on these coasts."

Evidence of this former occupation is to be found in the present state of the vegetation, which shows that cultivation at one time extended much further up the slopes than it does now. The clearing of the jungle and the subsequent denudation by rain exposes tumbled masses of granite boulders, between which the Malays build their houses and cultivate such food plants as Bananas, Tapioca and Caladium. Coconuts are planted on the sandflats of the little bays, and even amongst the boulders, appearing to thrive well enough wherever a little soil can collect. When abandoned, these cleared patches revert to a dense half-herbaceous, half-woody secondary growth much tangled by creepers, and later to poor secondary forest in which lianes are abundant.

At an altitude of about 400 to 500 feet above the village at Telok Berhala the jungle is poor, with few big trees and apparently no Dipterocarps. The undergrowth is dense with much tufted *Calamus* and *Daemonorops*, while in places the ground is covered with *Curculigo latifolia*. Large clumps of *Dendrocalamus sp.* are frequent, with *Aglaonema Schottianum* underneath them and an occasional specimen of the fungus *Dictyophora indusiata*. *Aralidium pinnatifidum*, with its bunches of irregularly shaped white fruits, was common and conspicuous.

On the rocky slopes nearer the sea, *Taxotrophis ilicifolia* is the commonest shrub under the trees, while masses of *Schefflera heterophylla* were seen scrambling over boulders.

At slightly higher altitudes—up to about 1,000 feet, *Orania macroclados* begins to appear in big clumps along with *Arenga saccharifera*. There is a greater depth of soil here and fewer exposed boulders, evidence, perhaps, that cultivation, if ever it did extend up the slopes as far as this, was abandoned very much earlier than that which altered the vegetation lower down. *Angiopteris sp.* begins to appear at about 700 feet, and *Homalomena purpurascens* carpets the ground in places at this altitude, replacing *Aglaonema Schottianum* of a few hundred feet lower.

Growing in large masses over bare boulders near sea level is *Quisqualis indica*, and associated with it is the common seashore orchid *Cymbidium Finlaysonianum* and the rarer *Haemaria discolor* var. *ordiana*.

As noted above, on the slopes of the ridge above the village at Telok Berhala, from about 600 ft. to 1,000 ft., *Arenga saccharifera* (Kabong), and *Orania macroclados* (Ibul), are exceedingly common. On Pulau Tinggi, Mr. Burkill reports, *Arenga Westerhoutii* (Langkap) takes the place of *A. saccharifera* and is associated with *Orania macroclados*. But on P. Tioman, *A. saccharifera* again appears and is very common up to an altitude of about 2,000 ft. being here associated with *Oncosperma horrida* (Bayas). *A. Westerhoutii* has not been reported authentically from P. Tioman, and the local Malays say that it is entirely absent from that island as it is from P. Aor. *Orania macroclados* occurs very sparingly on P. Tioman. These differences are interesting, but the reason for them is obscure.

Very little collecting has been done on P. Aor. J. B. Feilding visited it and P. Dayang in 1892 and made small collections which are in the Botanic Gardens, Singapore.

P. Dayang, to the north of P. Aor, is practically denuded of jungle and covered with coconut palms. The south aspect presents a smooth sloping face of rock with piled up masses of boulders at its base amongst which coconuts flourish. *Cycas Rumphii* was noticed in clefts of the rock, and *Spinifex squarrosus* was on the sandy beach. The latter appeared to be absent from P. Aor, or at least it was not seen on any of the sandy beaches visited.

## PULAU TIOMAN.

Pulau Tioman is a rugged island lying about 48 miles due east of the mouth of the Rompin river in Pahang, and distant from the nearest point of the Malay Peninsula about 20 miles. It is about 12 miles long from north to south and its greatest breadth is about 6 miles. It is entirely mountainous, the highest peak being 3,383 feet above sea level, two lesser peaks reaching a little over 3,000 ft.

At the present day the inhabitants of Tioman number about 800, and it is probable that the island never held a much greater population. Except for the sandy flats of the bays, there is no level ground for cultivation, and the inhabitants confine themselves to these bays, only clearing for a short distance up the lower hill slopes.

Kaempfer touched at Tioman on his voyage to Japan in 1690, for the Dutch East Indiamen were in the habit of putting in to draw wood and water unmolested when voyaging from Batavia to Siam. He remarks that the inhabitants " are a sort of Banditos who have been possessed of this island a considerable time and are of late grown so numerous that some years ago one of their Orang Kaya, who came on board one of our ships, boasted they were no

less than two thousand in number, tho' perhaps not half." He notes that the inhabitants wore bark-cloth and palm leaf hats and cultivated Mangos, Soursops, Pineapples, "small Lemons" and "Pinang trees." He does not mention the coconut palm. It is curious to note that the same type of small canoe with double paddles as Kaempfer describes is used to this day. (Kaempfer, Voyage to Japan, Vol. I, p. 5).

About 1849, J. T. Thomson visited Tioman and wrote an account of it in Logan's Journal, Vol. V. He gives the population as 200 and says that its produce was edible birds' nests, of which four piculs were exported yearly, dammar and other jungle products. Apparently even at this comparatively recent date, the cultivation of the coconut was of no importance on the island. Thomson remarks that "Tioman had been deserted to within these last ten years, having prior to that been subject to the attacks of the Illanuns. These pirates carried off 70 of the inhabitants about 20 years ago and sold them into slavery, during the interval the island remained desolate, the residue of the inhabitants that escaped from the pirates abandoned their homes, fleeing to Pahang, Johore and other places until the clearing of the coasts of this most formidable sect of sea marauders that infest the eastern seas had been effectually and it is to be hoped, finally accomplished in the year 1838."

"Pulo Tingi, Pulo Sibu, and adjacent islands also produce birds' nests." "The inhabitants, besides a little occasional quiet piracy, which it is not now either so profitable or so safe to indulge in, as formerly, spear the turtle, and gather their eggs, also collect beche-de-mer for the Singapore market."

P. Tioman has been visited for short periods by various collectors. Ridley collected a little in August 1889 on the west coast at a place he calls Nipa Bay. Nanson, a lawyer of Singapore, collected orchids for cultivation; and specimens of these, or of some of them, are in the Herbarium of the Singapore Botanic Gardens. Burkill accompanied Robinson on a visit from June 21st to June 29th, 1915, collecting at Joara Bay and west of it to an altitude of about 1,000 ft. He also visited Tanjong Duatah on the south coast and collected towards the base of the Chula Naga (the "Ass's Ears" of the charts). Kloss paid a short visit to Joara Bay in June, 1916, and collected plants which were sent to Kew.

The writer's collections were made between May 10th and May 29th, 1927. As the primary object of the visit was to collect at as high altitudes as possible, systematic collecting at low levels was at first neglected, although time was found later for a considerable amount of shore collecting.

A camp was established on the path which runs from Joara Bay on the east coast to Ayer Batang Bay on the west. This point, which is roughly half-way between these two places, is known as Sedagong and is about 1,000 feet above sea level. From here a path was cut to the summit of a hill called Gunong Rokam, which the local Malays said was the second highest point on the island. Altitudes were estimated with the help of an aneroid barometer, but it is thought that the instrument read low by as much as 200 feet, and that the summit of Rokam is about 3,000 feet, instead of 2,800 feet as shown on the aneroid. It is apparently the unnamed hill marked on the map of the Malay Peninsula published by the Straits Branch of the Royal Asiatic Society in 1911 and given there as 3,080 ft.

Tanah Runto is a large recent landslip on the northern face of Gunong Rokam. It is visible from the sea both from the north-east and north-west, and is said to have occurred during the heavy rains at the end of 1926. It extended from about 1,200 feet to 2,100 feet above sea level, and was, at a guess, 200 to 400 yards wide. The soil had been completely swept away, exposing the bare rock, over which ran a trickle of water. Vegetation had been obliterated, large trees being uprooted, pulverised and buried in the debris at the foot. Secondary growth had encroached on the edges to a depth of 20 or 30 yards, but the centre was still practically bare except for a few plants of two species of *Macaranga, Bridelia sp., Acroceras sparsum, Lycopodium cernuum,* and a small fern. These were the first colonists, but the slope was so steep and so completely swept of soil that there was little opportunity for any plant to find a foothold.

The ascent of Gunong Kajang (3,383 ft.) was made from the west coast. A camp was established at about 1,000 feet above Telok Paya, and from there a track was followed which led to a small cave (Gua Teh Angin) near the summit, where, it was said, edible birds' nests were periodically collected.

A distinctive feature of the Tioman forests is the presence of exposed granite boulders from between which rise tall trees. Such forest supports remarkably little undergrowth, probably on account of the excellent drainage, which withdraws water beyond the reach of the roots of shrubs, but not beyond the reach of those of large trees. When undergrowth does occur, it is made up to a great extent of bushes of *Taxotrophis ilicifolia,* which with its harsh holly-like foliage, is well suited to withstand dry soil conditions. The western side of the island is appreciably drier than the eastern, due, no doubt, to lesser rainfall.

The summit of Gunong Rokam is a mass of granite rocks covered with humus, supporting a shrubby growth

of such mountain-top plants as *Medinilla, Rhododendron, Vaccinium, Calamus,* and *Pandanus.* It is dry and not moss grown. The summit of Gunong Kajang, on the other hand, has mossy forest. It is a narrow boulder-strewn ridge running east and west, very precipitous on the north and south faces. The trees are 15 to 20 feet tall, thin and spindly, thickly crowded together, covered at the bases of the trunks with mosses and liverworts, which ascend the trunks for a foot or two. The boulders are likewise thickly covered with mosses and liverworts and between them and upon them is a dense cover of small trees, with a small tufted *Calamus* common on the ground. In the dampest spots amongst moss, a fine Cypripedium, perhaps *C. Bullenianum,* was common. Just below the summit is a small open patch covered with a dense undergrowth of grasses and sedges with *Nepenthes ampullaria* and *Lycopodium cernuum,* from which rise a number of old flat-topped trees of *Baeckia frutescens* and *Leptospermum flavescens,* fifteen to twenty feet tall.

The Trigonometrical Beacon, erected some twelve or thirteen years ago, is now obscured by a dense secondary growth.

According to Burkill, Gardens' Bulletin Vol. IV, pp. 176, 187, less than eight per cent. of the phanerogamic flora of Pulau Tioman, and about ten per cent. of the flora of the other islands under consideration were known. Perhaps our knowledge may now be put at about twenty per cent., assuming that the number of species the group possesses is approximately the same as the number known from Penang Island.

The following are the local and endemic species. An asterisk indicates that they come from above 2,000 ft., a dagger that they come below that altitude:—

†Canarium subcordatum, *Ridl.*
†Garcinia tenuifolia, *Ridl.*
*Eugenia ciliaris, *Ridl.*
†Eugenia tiomanensis, *Ridl.*
*Begonia tiomanensis, *Ridl.*
†Mussaenda spectabilis, *Ridl.*
†Lasianthus barbellatus, *Ridl.*
†Lasianthus chrysothrix, *Ridl.*
†Kopsia alba, *Ridl.*
†Paraboea tiomanica, *Burkill.*
† Justicia ovalis, *Ridl.*
†Litsea madulifolia, *Ridl.*
†Trigonostemon arboreum, *Ridl.*
*Oberonia tiomanensis, *Hend.*
*Coelogyne tiomanensis, *Hend.*
†Gastrochilus sub-biloba, *Valeton.*
† Calamus Burkillianus, *Becc*
*Carex leucostachys, *Ridl.*

All these plants are confined to Pulau Tioman, with the exception of *Canarium subcordatum,* which is known only from Pulau Tinggi, and *Garcinia tenuifolia,* which is known both from Tioman and Aor.

These eighteen plants give a figure of about four per cent. for the local specific endemism. Without doubt further exploration will raise this considerably, probably as much as three times, for it is to be expected that the local specific endemism of an isolated island like Tioman will exceed that of an area such as the Taiping Hills, for which the figure is about ten per cent.

Species with an extra-Peninsular distribution, not known from the Peninsula proper:—

†Allophylus javensis, *Bl.* (P. Aor). W. Malaysia to the Philippines.
†Allophylus timorensis, *Bl.* (P. Tinggi, P. Tioman). Malaya to Polynesia.
†Casearia leucolepis, *Turcz.* (P. Tioman). Borneo, Philippines.
†Zuccarinia macrophylla, *Bl.* (P. Aor). Java.
†Loxonia acuminata, *Br.* (P. Tioman). Sumatra, Java.
†Endospermum borneense, *Muell. Arg.* (P. Tioman). Borneo.
†Pipturus velutinus, *Wedd.* (P. Tinggi, P. Tioman). Malaysia.
†Boehmeria malabarica, *Wedd.* (P. Tioman). India to Borneo.

A considerable number of plants from these islands have hitherto been known only from the north and north-west of the Peninsula and are not known to cross to the eastern side of the Main Range. They are:—

Ternstroemia penangiana, *Choisy.*
Glycosmia rupestris, *Ridl.*
Atlantia monophylla, *Correa.*
Canarium hispidum, *Bl.*
Canarium pilosum, *Benn,* var. hirtellum, *Ridl.*
Paranephelium muricatum, *Pierre.*
Schefflera Curtisii, *Ridl.*
Schefflera venulosa, *Harms.*
Alangium begoniaefolium, *Baill.*
Randia exaltata, *Griff.*
Ixora multibrachiata, *Pearson.*
Pavetta naucleiflora, *Wall.*
Solanum decemdentatum, *Roxb.*
Cyrtandromoea repens, *Ridl.*
Balanophora insularis, *Ridl.*
Cleistanthus polyphyllus, *Williams.*
Baccaurea sapida, *Muell. Arg.*

Debregeasia squamata, *Hook. fil.*
Appendicula pendula, *Bl.*
Globba perakensis, *Ridl.*

and the following littoral plants:—

Erythrina indica, *Lam.*
Sophora tomentosa, *Linn.*
Pisonia aculeata, *Linn.*

Of these the following are endemic:—

*Ternstroemia penangiana, Canarium pilosum* var. *hirtellum, Schefflera Curtisii, Cyrtandromoca repens, Debregeasia squamata, Globba perakensis.*

The following extend into Siam only:—

*Glycosmis rupestris, Paranephelium muricatum, Ixora multibrachiata, Cleistanthus polyphyllus.*

The following have a distribution westwards of the Peninsula only:—

*Atlantia monophylla, Pavetta naucleiflora.*

The following have a distribution eastwards only:—

*Canarium hispidum, Appendicula pendula.*

The montane plants of Pulau Tioman, that is, those collected at 2,000 ft., or over, are as follows:—

Dysoxylum cauliflorum, *Hiern* also at sea level.
Gomphandra lanceolata, *King*, var. angustifolia, *King*
Allophylus glaber, *Roxb.* also at sea level in P. Tinggi.
Rubus glomeratus, *Bl.*
Dichroa febrifuga, *Lour.*
Baeckia frutescens, *Linn.*
Leptospermum flavescens, *Linn.*
Eugenia ciliaris, *Ridl.*
Eugenia pendens, *Duthie* also at low elevations.
Blastus Cogniauxii, *Stapf*
Sonerila erecta, *Jack*
Medinilla speciosa, *Bl.*
Begonia tiomanensis, *Ridl.*
Argostemma Hookeri, *King*
Argostemma spinulosum, *Clarke*
Argostemma unifolium, *Benn.*
Ophiorrhiza discolor, *R. Br.*
Hedyotis congesta, *Wall.*, var. nicobarica, *King*
Mussaenda mutabilis, *Hook fil.*, var. hirsuta, *King* also at sea level
Urophyllum trifurcum, *Pearson*
Ixora congesta, *Roxb.*
Ixora stricta, *Roxb.* also at sea level.
Psychotria sarmentosa, *Bl.* also at sea level.
Chasalia curviflora, *Thw.* also at sea level.

Cephaelis singaporensis, *Ridl.*
Lasianthus attenuatus, *Jack*
Hydnophytum formicarium, *Jack* also at sea level.
Vaccinium perakense, *Ridl.*
Rhododendron jasminiflorum, *Hook.*
Hoya latifolia, *Don*
Didymocarpus corchorifolia, *R. Br.*
Paraboea densifolia, *Hend.*
Cyrtandromoea acuminata, *Benth. and Hook.*
Strobilanthes latebrosa, *Ridl.*
Justicia vasculosa, *Wall.*
Nepenthes ampullaria, *Jack*
Litsea johorensis, *Gamble*
Breynia discigera, *Muell. Arg.*
Croton erythrostachys, *Hook. fil.*
Trigonostemon longifolius, *Baill.* also at sea level.
Claoxylon longifolium, *Muell. Arg.*
Ficus diversifolia, *Bl.*, var. lutescens, *King.*
Ficus fistulosa, *Reinw.*
Oberonia tiomanensis, *Hend.*
Liparis elegans, *Lindl.*
Liparis Wrayi, *Hook. fil.*
Dendrobium hercoglossum, *Rchb. fil.*
also at sea level.
Dendrobium sinuatum, *Lindl.*
Eria nutans, *Lindl.*
Eria teretifolia, *Griff.*
Coelogyne tiomanensis, *Hend.*
Calanthe veratrifolia, *R. Br.*
Bromheadia palustris, *Lindl.*
Appendicula pendula, *Bl.*
Podochilus microphyllus, *Lindl.*
Gastrochilus plicata, *Ridl.* also at sea level.
Amomum ?xanthophlebium, *Baker.*
Smilax calophylla, *Wall.*
Susum malayanum, *Hook.*
Nenga macrocarpa, *Scort.*
Licuala modesta, *Becc.*
Daemonorops calicarpus, *Mart.* also at sea level.
Calamus Diepenhorstii, *Miq.* also at sea level.
Gahnia tristis, *Nees.*
Hypolytrum latifolium, *Rich.* also at sea level.
Carex cruciata, Wall.
Carex leucostachys, *Ridl.*
Digitaria marginata, *Link.*, var. commutatum, *Hook. fil.*
Lophatherum gracile, *Brngn.*
Dendrocalamus pendulus, *Ridl.*
Podocarpus imbricatus, *Bl.*
Podocarpus neriifolius, *Don.*

Of these 72 plants, 20 are usually lowland in the Peninsula, 34 are usually montane, and the rest have a wide range of altitude. Thirty-seven per cent. are endemic (*i.e.*, confined to the Peninsula).

In considering the collections as a whole from the point of view of specific endemism, littoral plants and plants which owe their presence on the islands directly or indirectly to man, have been excluded. The percentage of specific endemism is then found to be about 23, a figure which is undoubtedly much too low when it is remembered that, on Tioman at least, the original forest covering has been interfered with by man to a very small extent indeed. Pulau Tioman, at least with reference to its flora, is to be considered part of the Malay Peninsula, and its specific endemism should reach to between forty and fifty per cent. Much more collecting is necessary, in every season of the year, before definite conclusions can be drawn.

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The writer is indebted to Mr. H. N. Ridley for determinations of several plants; and to Mr. I. H. Burkill for determinations of the Dioscoreas, and for extracts from the diary of his trip to P. Tinggi and P. Tioman in 1915.

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Canarium hispidum, *Bl.* (Burseraceae). P. Aor on the jungle edge, Henderson 18242. This is very rare in the Peninsula, hitherto being known only from Gapis in Perak. It also occurs, however, in Sumatra, Borneo, Java and Celebes.

Paranephelium muricatum, *Pierre* (Sapindaceae). P. Tioman, path across island at about 1000 ft. altitude, Burkill s. n. Very rare in the Peninsula, hitherto known only from Chupeng and Siam. Burkill's specimen agrees closely with the Chupeng specimen, determined by Ridley, but whether this is really Pierre's species appears to be somewhat doubtful. (see Ridl., Flor. Mal. Pen., I, p. 509).

Bauhinia glauca, *Wall.* (Leguminosae). P. Tioman, Ayer Batang at sea level, Henderson 18458; Ayer Surin at about 900 ft., creeping on rocks in open watercourse, Henderson 18950. Rare in the Peninsula, known only from Kota in Perak, and Kuala Lipis in Pahang. Distrib: Tenasserim.

Dichroa febrifuga, *Lour.* (Saxifragaceae). Gunong Rokam, P. Tioman, at an altitude of about 2700 ft., in forest, Henderson 18776. This is not particularly common in the Peninsula on the Taiping Hills and on the Main Range, its southern limit being apparently about Ginting Bidai in Selangor. It is a Himalayan type and extends eastward as far as S. China.

Quisqualis indica, *Linn.* (Combretaceae). On P. Aor, scrambling in great masses over granite boulders on the edge of old clearings almost at sea level, Henderson 18227. This is very rarely found in a truly wild state in the Peninsula, and it is doubtful if it is wild on P. Aor.

Ixora plumea, *Ridl.* (Rubiaceae). This plant was found on P. Tioman about 150 ft. above sea level at Bukit Sukak in rather dry open forest, Henderson 18552. An examination of the specimens in Herb. Singapore leads me to the conclusion that *I. plumea,* Ridl. is not distinct from *I. arguta,* Ridl., and must be reduced to that species. *I. arguta,* Ridl. was obtained on P. Aor at about 700 ft. altitude, Henderson 18212.

Planchonella oxyedra, *Dub. (1912).* (Sapotaceae). *H. J. Lam, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 4, p. 474.* Sideroxylon littorale, *Ridl., Flor. Mal. Pen. II, p. 259.* Found on P. Tinggi, Burkill 876, and on the small island P. Tulai to the N. W. of P. Tioman, Henderson 18512. This is very rare in the Peninsula, being known only from Kuantan, but it is widely distributed from Sumatra to the Lesser Sunda Islands, and not necessarily a littoral plant.

Diospyros caliginosa, *Ridl.* (Ebenaceae). P. Tioman, west of Joara Bay, Burkill 998. A species endemic in the Peninsula and very rare.

Diospyros cymosa, *Ridl.* P. Tioman, Ayer Besar at about 800 ft. altitude, Henderson 18864. This has been recorded previously only from Telok Sisih, Kuantan.

Ochrosia borbonica, *Gmel.* (Apocynaceae). P. Tioman, south of Joara Bay, Burkill s. n. A seashore plant, but very rare in the Peninsula. It was collected once by Wallich in Singapore, and by Ridley on Pulau Adang.

Deeringia indica, *Zoll.* (Amarantaceae). P. Tioman, Sedagong in forest at about 1000 ft. altitude, Henderson 18892. This plant is not very common in the Peninsula, being confined usually to limestone.

Rafflesia Hasseltii, *Suringar* (Cytinaceae). P. Tioman, Sedagong at about 900 ft. altitude in forest, Henderson 18395, 18908. Not very common in the Peninsula, but fairly widely distributed. It is known also from Sumatra.

Peperomia kotana, *C.DC.* (Piperaceae). P. Tioman, Sungai Tawar at sea level, Burkill 1004. A rare plant, hitherto known only from the limestone at Kota Glanggi, Pahang.

Ficus Scortechinii, *King* (Urticaceae). P. Tinggi, Bukit Treh, Burkill 954. A rare species, collected only once before by Kunstler at Kampar, Perak.

Licuala modesta, *Becc.* (Palmae). P. Tioman, Gunong Kajang, 3300 ft., Henderson 18611. A small palm, not common in the Peninsula, and hitherto known only from the Taiping Hills and Kuala Kangsar.

## LIST OF ADDITIONS TO THE FLORA OF THE MALAY PENINSULA.

The following list brings together in one convenient place the names of all additions to the Flora of the Malay Peninsula since the publication in 1925 of the last volume of Ridley's "Flora of the Malay Peninsula."

The original place of publication of the species is given, with other references where necessary, and an indication is given of the localities from which the plants come.

The most important publications dealing with the flora of the Peninsula, and those in which most additions will be found are the Kew Bulletin of Miscellaneous Information, the Bulletin of the Botanic Gardens at Buitenzorg in Java (Bulletin du Jardin Botanique de Buitenzorg), and the Gardens' Bulletin, Straits Settlements. Other publications in which additions may from time to time be found are the Journal of the Malayan Branch of the Royal Asiatic Society, the Journal of the Federated Malay States Museums, and the Journal of Botany, British and Foreign.

It is intended to keep this list up to date by publishing supplementary lists at intervals of about a year.

### MAGNOLIACEÆ.

**Pachylarnax praecalva,** *Dandy,* Kew Bulletin, 1927, p. 260. Penang.

**Talauma betongensis,** *Craib,* Kew Bulletin, 1925, p. 7; Dandy, l.c., 1928, p. 189. Kedah Peak.

**Talauma gracilior,** *Dandy,* Kew Bulletin, 1928, p. 190. Kedah Peak.

**Talauma peninsularis,** *Dandy,* Kew Bulletin, 1928, p. 192. Pahang: Jerantut.

### ANONACEÆ.

**Drepananthus pahangensis,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 48. Pahang: Baloh; Pulau Manis; Kuantan. Johore: Gunong Panti.

**Goniothalamus rotundisepalus,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 48. Kelantan: Sungai Renong.

### FLACOURTIACEÆ.

**Hydnocarpus Humei,** *Ridl.,* Kew Bulletin, 1926, p. 470. Selangor: Klang Gates.

### GUTTIFERÆ.

**Garcinia tenuifolia,** *Ridl.,* Kew Bulletin, 1928, p. 72. Pulau Tioman.

DIPTEROCARPACEÆ.

**Dipterocarpus costulata,** *van Slooten,* Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 2–3 (1927). p. 315. Negri Sembilan: Kuala Pilah.

**Dipterocarpus Hasseltii,** *Blume,* Flor. Jav. II, 22, t.6 (1828–29); van Slooten, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 2–3 (1927) p. 281. Pahang: Kuala Lipis and Temerloh.

**Dipterocarpus verrucosa,** *Foxworthy. van Slooten,* Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 2–3 (1927) p. 293. Selangor: Kajang. Negri Sembilan: Seremban.

**Vatica bella,** *van Slooten,* Bull. Jard. Bot. Buitenzorg, Serie III, Vol. IX, Livr. 1–2 (1927) p. 102. Johore: Kluang.

STERCULIACEÆ.

**Sterculia alata,** *Roxb.,* Hort. Beng. 50; Pl. Coromand. iii, 84, t.287; Hend., Gard. Bulletin Vol. IV, p. 411. Kelantan. Perak. Negri Sembilan.

**Sterculia Holttumii,** *Ridl.,* Kew Bulletin, 1926, p. 471. Trengganu: Pulau Kapas.

**Sterculia microphylla,** *Ridl.,* Kew Bulletin, 1926, p. 470. Perak: Kuala Kangsar.

**Helicteres lanceolata,** DC., Prod. i. 476; *Hend.,* Gard. Bulletin Vol. IV, p. 411. Pulau Langkawi.

BALSAMINACEÆ.

**Impatiens Foxworthyi,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 50. Limestone rocks, Kelantan-Pahang boundary.

ILICACEÆ.

**Ilex nitens,** *Ridl.,* Kew Bulletin, 1926, p. 471. Pahang: Gunong Benom.

MYRTACEÆ.

**Eugenia ciliaris,** *Ridl.,* Kew Bulletin, 1928, p. 74. Pulau Tioman.

**Eugenia saxitana,** *Ridl.* Kew Bulletin, 1928, p. 74. Gunong Tahan.

MELASTOMACEÆ.

**Allomorphia longisetosa,** *Ridl.,* Kew Bulletin, 1926, p. 471. Johore: Gunong Panti.

**Sonerila johorensis,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 411. Johore: Gunong Panti.

**Sonerila Whittyi,** *Hend.,* Jour. Mal. Br. Roy. As. Soc. Vol. V, part 2, p. 262. Pahang: Cameron's Highlands.

BEGONIACEÆ.

**Begonia tiomanensis,** *Ridl.,* Kew Bulletin, 1928, p. 73. Pulau Tioman.

RUBIACEÆ.

**Argostemma nigrum,** *Hend.,* Jour. F.M.S. Museums, Vol. XIII, part 4 (1927) p. 220. Pahang: Gunong Benom.

**Pomozota rivularis**, *Hend.*, Gard. Bulletin, S.S., Vol. IV, p. 411. Johore: Gunong Muntahak.

## COMPOSITÆ.

**Eupatorium conyzoides**, *Vahl*, Symb. Bot. iii, 96; *Hend.*, Gard. Bulletin, Vol. IV, p. 412. Perak: Taiping.

## MYRSINACEÆ.

**Ardisia benomensis**, *Hend.*, Jour. F.M.S. Museums, Vol. XIII, part 4 (1927) p. 221. Pahang: Gunong Benom.

**Ardisia viminea**, *Ridl.*, Kew Bulletin, 1926, p. 472. Selangor: Ulu Gombak.

## SAPOTACEÆ.

**Palaquium calophyllum**, *Pierre in Burck*, Ann. Jard. Bot. Buitenzorg V (1886) 28; Lam, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2, p. 52. Pahang: Kuala Lipis, cultivated.

**Palaquium ferox**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925), p. 70; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 401. Pahang: Temerloh.

**Palaquium hispidum**, H. J. Lam, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 63; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 400. Pulau Langkawi. Upper Perak. Pahang. Negri Sembilan.

**Palaquium macrocarpum**, *Burck*, Ann. Jard. Bot. Buitenzorg, V (1886) 32; Lam, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 79; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 408. Upper Perak. Negri Sembilan.

**Palaquium semaram**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 43; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 397. Pahang: Pontian. Johore: Sungai Mersing.

**Palaquium walsurifolium**, *Pierre ex Dubard*, Bull. Soc. Bot. Fr., LVI (1909), Mem. 16, 22; Lam, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 77; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 407. Negri Sembilan.

**Payena lancifolia**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 147; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 438. Pahang: Temerloh; Fraser Hill.

**Madhuca Dubardii**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 162; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 444. Selangor: Ayer Hitam and Bukit Tunggal.

**Madhuca ovata**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VII, Livr. 1–2 (1925) p. 170; Lam, l.c., Vol. VIII, Livr. 4 (1927) p. 451. Pahang: Temerloh.

**Madhuca tubulosa**, *H. J. Lam*, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 4 (1927), p. 456. Johore: Penyabong and Panti.

OLEACEÆ.

**Jasminum cordatum,** *Ridl.,* Kew Bulletin, 1926, p. 473. Perak: Gunong Lanoh.

ASCLEPIADIACEÆ.

**Dischidia Fultonii,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 51. Johore: Gunong Belumut.

LOGANIACEÆ.

**Fagraea speciosa,** *Blume,* Rumphia ii, 35, t.81; Hend., Gard. Bulletin, Vol. IV, p. 412. Pahang-Kelantan boundary.

SCROPHULARIACEÆ.

**Herpestis floribunda,** R.Br., Prod. 442; Hend., Gard. Bulletin, Vol. IV, p. 51. Kuala Trengganu.

GESNERACEÆ.

**Aeschynanthus Flippancei,** *Ridl.,* Kew Bulletin, 1926, p. 473. Penang: Balik Pulau.

**Didissandra breviflora,** *Ridl.,* Kew Bulletin, 1926, p. 474. Selangor: Ulu Gombak.

**Didymocarpus lancifolia,** *Hend.,* Gard. Bulletin, Vol. IV, p. 52. Pahang: Raub.

**Loxocarpus Holttumii,** *Hend.,* Gard. Bulletin, Vol. IV, p. 412. Johore: Gunong Panti.

**Loxocarpus papillosa,** *Hend.,* Gard. Bulletin, Vol. IV, p. 53. Negri Sembilan: Gunong Angsi.

**Paraboea Holttumii,** *Hend.,* Gard. Bulletin, Vol. IV, p. 53. Johore: Gunong Belumut.

ACANTHACEÆ.

**Hemigraphis Ridleyi,** *Clark,* Jour. As. Soc. Bengal, Vol. LXXIV, part II, p. 652, var **nervosa,** *Hend.,* Gard. Bulletin, Vol. IV, p. 54. Pahang: Kuala Lipis.

**Gymnostachyum hirtum,** *Ridl.,* Kew Bulletin, 1926, p. 474. Perak: Kuala Kangsar.

**Justicia trichodes,** *Ridl.,* Kew Bulletin, 1926, p. 475. Selangor: Seminyih.

VERBENACEÆ.

**Vitex Millsii,** *Hend.,* Jour. Mal. Br. Roy. As. Soc., Vol. V, part 2, p. 262. Pahang: Cameron's Highlands.

LABIATÆ.

**Hyptis capitata,** *Jacquin,* Collecteana 1 (1786) 102; Furtado, Gard. Bulletin, Vol. IV, p. 415. Singapore.

PHYTOLACCACEÆ.

**Rivina humilis,** Linn. Spec. Plant. (1753) 121; Furtado, Gard. Bulletin, Vol. IV, p. 415. Singapore.

POLYGONACEÆ.

**Polygonum malaicum,** *Danser,* Bull. Jard. Bot. Buitenzorg, Serie III, Vol. VIII, Livr. 2–3 (1927) p. 218; Hend., Jour. Mal. Br. Roy. As. Soc., Vol. V, part 2, p. 263. Main Range.

NEPENTHACEÆ.

**Nepenthes alata,** *Blanco,* Fl. Fil. ed.l, p. 805 (1837); Danser, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. IX, Livr. 3–4 (1927-1928) p. 258. Pahang: Gunong Tahan.

**Nepenthes Hookeriana,** *Lindl.,* Gardeners' Chronicle, 1848, p. 47; Danser, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. IX, Livr. 3–4, p. 309. Singapore: Chan Chu Kang and Jurong.

**Nepenthes laevis,** *Lindl.,* Gardeners' Chronicle, 1848, p. 655; Macfarlane, Kew Bulletin, 1926, p. 468. Singapore: Changi.

**Nepenthes Reinwardtiana,** *Miq.,* Pl. Jungh., p. 168 (1852); Danser, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. IX, Livr. 3–4, p. 363. Pahang and Singapore.

**Nepenthes trichocarpa,** *Miq.,* Fl. I, 1, p. 1072 (1858); Danser, Bull. Jard. Bot. Buitenzorg, Serie III, Vol. IX, Livr. 3–4, p. 389. Singapore: Changi.

LAURACEÆ.

**Beilschmiedia longipedicellata,** Ridl., Kew Bulletin, 1926, p. 475. Selangor: Seminyih.

LORANTHACEÆ.

**Loranthus pekanensis,** *Hend.,* Gard. Bulletin, S.S., Vol. IV, p. 55. Pahang: Pekan.

EUPHORBIACEÆ.

**Buxus malayana,** *Ridl.,* Kew Bulletin, 1926, p. 475. Perak: Gunong Lanoh.

**Sauropus elegantissimus,** *Ridl.,* Kew Bulletin, 1926, p. 476. Selangor: Ulu Gombak.

**Galearia lancifolia,** *Ridl.,* Kew Bulletin, 1926, p. 476. Selangor: Klang Gates and Ulu Gombak.

**Trigonostemon arboreus,** *Ridl.,* Kew Bulletin, 1928, p. 75. Pulau Tioman.

ORCHIDACEÆ.

**Bulbophyllum cheiropetalum,** *Ridl.,* Kew Bulletin, 1926, p. 477. Kedah Peak.

**Bulbophyllum Evansii,** *Hend.,* Jour. F.M.S. Museums, Vol. XIII, part 4, p. 224. Pahang: Gunong Benom.

**Bulbophyllum Hodgsoni,** *Hend.,* Jour. Mal. Br. Roy. As. Soc., Vol. V, part 2, p. 273. Pahang: Cameron's Highlands.

**Eria callosa,** *Hend.,* Jour. F.M.S. Museums, Vol. XIII, part 4, p. 225. Pahang: Gunong Benom.

**Eria rigida,** *Blume,* Mus. Bot. Lugd. Bat. ii, 183; Hend., Gard. Bulletin, Vol. IV, p. 414. Pahang: Chegar Perah.

**Eria Teysmanni,** *J. J. Smith,* Bull. Dep. Agric. Indes Neerl. xxii, 29; Hend., Gard. Bulletin, Vol. IV, p. 414. Kelantan: Kuala Pertang.

**Saccolabium macrantherum,** *Ridl.,* Kew Bulletin, 1926, p. 478. Selangor: Ulu Gombak.

ZINGIBERACEÆ.

**Alpinia Burkillii,** *Hend.*, Gard. Bulletin, S.S., Vol. IV. p. 55. Pahang: Kuantan Road. Negri Sembilan: Gemas.

**Hedychium paludosum,** *Hend.*, Jour. Mal. Br. Roy. As. Soc., Vol. V, part 2, p. 273. Pahang: Cameron's Highlands.

DIOSCOREACEÆ.

**Dioscorea Owenii,** *Prain & Burkill,* Kew Bulletin, 1925, p. 63. Singapore, cultivated.

CYPERACEÆ.

**Carex leucostachys,** *Ridl.*, Kew Bulletin, 1928, p. 77. Pulau Tioman.

GRAMINEÆ.

**Pollinia Hendersoni,** *Hubbard,* Kew Bulletin, 1927, p. 79; Hend., Jour. Mal. Br. Roy. As. Soc., Vol. V, part 2, p. 276. Pahang: Cameron's Highlands.

M. R. HENDERSON.

# THE CHINESE MUSTARDS IN THE MALAY PENINSULA.

— BY —

I. H. BURKILL, M.A., F.L.S.

In order to determine what scientific names ought to be applied to the mustards which the Chinese have brought into the Malay Peninsula, I asked Mr. R. E. Holttum, Director of Gardens, Straits Settlements, to get seed for me, and received from him nine samples, obtained in Singapore, followed later by two more, sent at his request from Penang by Mr. F. Flippance. I cultivated the mustards in my own garden; and also they were grown for me in the Royal Botanic Gardens, Kew. My best thanks are offered to Dr. A. W. Hill, the Director, for his service, as well as to Mr. Holttum and to Mr. Flippance for the seed.

The mustards were found to be:—

*Brassica oleracea,* Linn., var. *acephala,* a very precocious kind of kale, called in malay " sawi hijau tuah ", and not differing in much from a race to which Professor L. H. Bailey has given specific rank with the name *B. albo-glabra.*

*Brassica juncea,* Linn., var. *rugosa,* Prain, a race very close to the race grown as " pasai " in the Himalaya.

*Brassica campestris,* Linn., sub-species *B. napus,* Linn., var. *dichotoma,* Prain, a race very close to the " tori " of India. And

*Brassica campestris,* Linn., sub-species *B. chinensis,* Linn., vars. *pekinensis* and *brassicata,* which are peculiarly chinese.

As far as my knowledge goes, *Brassica nigra,* Linn., the Black mustard of Europe, is not among the species grown in the Peninsula, *B. juncea* having been mistaken for it in various writings.

To ascertain the right varietal names for use, has not been easy. Under the International Rules of Nomenclature, the author of a variety can choose his name without regard to priority, but it is always advisable that he should use the oldest reasonable name, lest when someone by a stroke of the pen raises that variety to the rank of a species the adjective be changed. I have therefore gone rather fully into the names which have been given to eastern races of *B. campestris* and *B. juncea.*

The Malays cannot have known these mustards until the Chinese brought them southward; and the Chinese as far as it is possible to determine, have been the people who by selecting the most precocious lines made them what they are.

When the Malays became acquainted with them they named them "sawi-sawi" or "sesawi", and it is interesting to enquire why they were so called. "Sawi ayer" is *Ilysanthes antipoda,* Merr., and so also is "sawi tanah": "sawi enggang" and "sawi hutan" are *Hyptis brevipes,* Poir.: "sawi pasir" is *Artanema angustifolium,* Benth.: "sawi lemah" in Java is *Nasturtium indicum,* DC.: and there too "sawi rana" is *Lactuca indica,* Linn. All these plants are herbs. The first is commonly used for poulticing: the others may be used as green vegetables. *Lactuca indica* is a Chinese importation into Malaysia, and is freely grown for eating. The other three are collected wild to add to other food, but are not often resorted to. Therefore until another explanation is forthcoming, it is reasonable to hold that on making acquaintance with these mustards in Chinese cultivation, the Malays classified them as pot-herbs of inferior value,—bastard—sawis; and "sawi" was not of much account.

The Chinese on the other hand set great store by them in their own country, so that their markets are seasonally full of them. In the Ying-yai Sheng-lan, which was compiled in China in 1416, it is recorded that the Chinese could obtain them, or one of them, in Malacca (see Groenevelt in Verhandl. Bataviaash Genootsch., 39, 1877, p. 125): and if the statement is correct, it suggests that a Chinese trading settlement was well established there, the Chinese endeavouring to live their habitual lives; though the climate of Malaya does not allow these mustards to produce seed in an adequate way, and therefore at that time, as it is now, a periodic import must have been necessary. We do not know how long the seed retains its vitality in Malaya; but the horticultural firm of Vilmorin-Andrieux and Co., who have experimented with *B. chinensis* in France give to it a life of five years (Les plantes potageres, 1904, p. 490); but the age was an age of great trading activity on the part of China, and the import of seed of the mustards from the home-country would be easy; for the coming and going of embassies alone, without additional trading voyages, would seem to have been frequent enough to maintain the seed-supply.

Any mustard, to be able to grow in Malaya must be of a precocious race.

A cook maintains *B. juncea* to be as a vegetable inferior to *B. campestris* and to *B. oleracea,* because in consequence of the pungency which it possesses, it must be boiled twice, —once and the water thrown away to carry off the pungent taste, and a second time to complete the cooking. *B. campestris-chinensis,* on the other hand is so free from pungency that it may be eaten as a salad.

Gardens Bulletin, S.S.

## KEY BY WHICH THESE MUSTARDS MAY BE DISTINGUISHED.

Flowers large and deep, as are those of the cabbage, pale yellow or rarely white..... *B. oleracea*
sawi hijau tuah

Flowers smaller, the claw of the petals about as long as the blade, and scarcely as long as the calyx, colour bright yellow:

Pods, the fertile part 3—4 cm. long and 1 cm. in circumference, more or less upright towards maturity, and in taste somewhat pungent:

Leaves at the base of the stem elliptic-ovate, not auricled: stem leaves not auricled: height of the plant about 50 cm..... *B. juncea*
sawi hitam

Leaves at the base of the stem lyrate, auricled: stem leaves auricled: height of the plant about 30 cm. ..... *B. campestris-napus*
sawi biji

Pods, the fertile part, 5—5.5 cm. long and about 1.5 cm. in circumference, spreading outwards in consequence of their weight at maturity: in taste mild
..... *B. campestris-chinensis*
sawi puteh

Leaves thin like lettuce, slightly glaucous, those of the basal rosette with the blade decurrent down the broad greenish-white petiole sometimes to the base or sometimes half way
..... var. *pekinensis*
sawi puteh daun besar

Leaves in life a little firmer, dark green, those of the basal rosette with distinct petioles which are white, and white veins run from them into the blade..... var. *brassicata*
sawi puteh daun kechil

Petioles very distinct from the blade, pure white entirely without wings, teeth or lobules: the mid-stem-leaves also petioled, and only the topmost sessile and auricled.....purest race

Petioles absent from the mid-stem-leaves

Basal leaves with a lobule on each side of the petiole.....a less pure race

Basal leaves with a few teeth on the sides of the petiole and this greenish
.....a race approaching var. *pekinensis*

*Brassica oleracea, Linn.*

When the seed of the mustards was received, it was evident by the size of the individual grains that "sawi hijau tuah" was different from the rest: and further its

Chinese name —kakna— which was given alongside the Malay name appeared more like a Japanese word than a Chinese word. When grown it proved to be a very precocious kale, assignable like the European kales to the variety *acephala* of *B. oleracea.*

It forms no rosette of leaves, but the early ones are approximated and of gradually increasing size up to the number (in my cultures) of 5—8. After their formation, the flowering stem grew out, with stem-leaves rapidly decreasing in size; and it flowered in a little more than two months from sowing. The capsules ripened tardily, and meanwhile from the larger leaves side-branches grew which in autumn gave a second flowering. The flowers on every plant but one were pale yellow, the exception having white flowers. At maturity the pods were 5–6 cm. long, slightly curved in the upper third and in section between elliptic and diamond-shaped. The seeds were 2.5 mm. in diameter.

The Malay name seems to refer to the duration of the leaves, or to the pods keeping green at seed-ripening.

The white-flowered plant agreed with the description and figure which Professor L. H. Bailey gave in his *Gentes herbarum* (part 2, 1922, p. 79) of his *B. alboglabra,* and I cannot find any reason why the yellow-flowered plants should be regarded as differing from it by more than racial characters. I suggest therefore, that when it is wished to carry differentiation so far, his white-flowered plant and my pale yellow-flowered plant be considered as races of subvar. *albo-glabra.* Professor Bailey had received his seed from Canton and also from Nanking.

It is more than probable that this southern race, cultivable in Malaya, exists in intermediate places: and there is mentioned by Crevost and Lemarié (Bull. Econ. Indo-chine, 23, 1921, p. 143) a cabbage of Tonkin called " cay-lan " which is sown in October and flowers in the end of January, with, it seems, a possibly close relationship to " sawi hijau tuah."

*Brassica juncea,* Coss. aut Czern.

" Sawi hitam " proved to be the tallest of the Chinese mustards. Seedlings produced a rosette of leaves on germination; and from the middle of this rosette the flowering stem grew out with leaves of very much decreased size and conspicuously different shape. The bright yellow flowers appeared 6—8 weeks after sowing in spring crops; and the inflorescences elongated so as to space these flowers considerably. The capsules were carried in a nearly erect position: they reached 3–4 cm. in length and in section were elliptic. When the capsules of the first flowering were ripening, short branches grew from the axils of the lower stem-leaves, which branched again so as to produce

fascicles of flowering stems, which in April-sown plants bore fruit rather unevenly in October. The pungency of the plant has already been mentioned.

" Sawi hitam " is very like the race of *B. juncea* grown in the Himalaya under the name of " pasai." This race was described by Roxburgh as *Sinapis rugosa* (Flora Ind. 3, 1832, p. 122) ; and it seems right, considering " pasai " and " sawi hitam " to be races of the same variety, to call the latter *Brassica juncea,* var. *rugosa,* Prain.

The better to justify this I propose to give an account of the attempts of botanists to understand *B. juncea,* that out of it, we may try to find more or less permanent names for the other varieties which can be recognised.

In the first place it is desirable to say how I understand the species. Like *B. nigra* it is a pungent mustard; for that reason it has not offered to man such great possibilities as *B. campestris;* and has been less selected. It is more nearly tropical than *B. nigra,* stands heat better and is fairly drought-resistant. For backward agricultural communities it offers the advantage over *B. campestris* of being disliked, on account of its pungency, by various pests which the communities do not control. It is an Old World plant at home in the rather dry parts of North and Central Africa, the Levant, the north of India and probably the interior of China. Otto Kuntze (in Acta Hort. Petrop. 10, 1887, p. 164) stated it to be " nothing but a glabrous cultivated and tropical form of *B. arvensis,* Rabenhr." but such a view is too extreme. It is a good species not difficult to isolate. On the other hand it has a long synonymy because its polymorphism has not been understood: and this polymorphism has been due to selection of variations by man. The African has done little in this direction, but has used the plant considerably from wild sources or in a nearly wild condition. Dr. A. Chevalier (in Bull. Soc. d'Acclimatation, 1912, p. 67) records that it is eaten on the Upper Niger: Hens upon the label of a plant collected in the Congo, and Meller on the label of another collected on the Zambesi, state that it is eaten: A. Braun (in Flora, 24, 1841, p. 267) mentions it as a local vegetable in Abyssinia: and Muschler in his *Flora of Egypt* (1912, p. 412) writes that it is eaten in that country. It is evident that it reached the West Indies with Negro slaves from Africa. It is also in Venezuela and in Brazil. It would not have been carried across to the New World had it not served some purpose, and evidently it was taken because it was a vegetable. The Asiatics have had a much greater effect upon the plant: they have selected food-races with a convenient production of bunched leaves, and oil-races grown for seed. And the further one goes east in Asia the more is the selection evident. Russia in the end of the

18th century adopted its cultivation as an oil crop, first in the Saratov Government, and then in the Astrakan Government, and also elsewhere in the southern parts of the country. The agriculture was backward, and it was found to be a crop which the marmots spared (Industries of Russia, 3, 1893, p. 155). Western Europe in the course of importing wheat, etc., during the nineteenth century and since, has often received its seed from regions where *B. juncea* is a crop or a weed, and it has sprung up as an adventive plant about the ports. The islands to the east and south of Asia have received it, not so much as an adventive plant as by the bringing in of cultivated races. The bringing of its seed by the Chinese to Malaysia has already been mentioned. Perhaps the Hindu conquerors of parts of Java took it to that island, which would be more or less about 400 A.D. In 1830 Matthews collected it "near the huts of natives" in the Friendly islands: and thirty years later Seemann found it in Fiji, upon which he thought Europeans had brought it; but then he mistook it for *B. nigra* (Flora Vitiensis, 1865, p. 5).

When first described by Linnaeus as *Sinapis juncea* it was said to be Chinese; but neither of those two excellent pioneers, Thunberg and Loureiro, who worked in the East immediately after Linnaeus' time were able clearly to recognise it: and in the following half century it obtained a new name with each extension of known range, so that the list is a long one. To clear the ground the names will be given at once.

1753. *Sinapis juncea*, Linn. A "chinese" race with pinnatifid lower leaves, which was grown in the Upsala Botanic Garden from seeds sent by (?) J. G. Gmelin.

1784. *Sinapis cernua*, Thunb. only as regards the Japanese name, and use.

1790. *Sinapis chinensis*, var., Lour., being two races which Loureiro had found in Indo-China. These became in 1812 *S. chinensis* var. *integrifolia*, Stokes.

1793. *Sinapis integrifolia*, Vahl, being the African plant as it occurs frequently in the West Indies.

1803. *Sinapis integrifolia*, Willd., a plant grown in the Berlin Botanic Garden, which was said to have come from the East Indies.

1809. *Sinapis campestris*, Besser, *or Brassica besseriana*, Andrzieowski ex Trautvetter in 1840, a plant with fugaceous lower leaves, and obovate doubly dentate stem leaves, which was first found on hills and in fields near Cracow.

1810. *Sinapis ramosa*, Roxb., the "rai" cultivated in Northern India.

1821. *Sinapis timoriana,* DC., a plant of Timor with characters such as the last possesses.

1821. *Sinapis lanceolata,* DC., the African race which has been introduced into the West Indies.

1832. *Sinapis patens,* Roxb., a wild plant found in India, which Sir David Prain regarded as a reversion from "rai," but is very like African plants.

1832. *Sinapis rugosa,* Roxb., the "pasai" of the Himalaya.

1832. *Sinapis cuneifolia,* Roxb., the "lahi sag" of the Himalaya.

1841. *Brassica carinata,* A. Braun, a plant used as a vegetable in Abyssinia.

1842. *Brassica willdenowii,* Boiss., a plant found at Muscat, and thought by the author of the name to be identical with *Sinapis integrifolia,* Willd.

1856. *Brassica lanceolata,* Lange, an adventive plant which reached Denmark probably from the nearer East.

1857. *Brassica dillenii,* Touchy, an adventive plant which reached southern France.

1898. *Brassica dentata,* Watt ex Prain, a race found in north-eastern India and appearing as if poorly grown *Sinapis rugosa,* Roxb.

1903. *Brassica urbaniana,* O. E. Schulz, the African race which has been introduced into the West Indies.

It is necessary next to enquire into the origin of these names, in order to know how to apply them to the varieties of *B. juncea.*

This species was first described in the 17th century by Sir Hans Sloane as *Sinapi foliis subrotundis serratis semine rufo.* He figured a branch of it, and preserved two imperfect specimens. He had obtained it in Jamaica: and there is but little doubt that his name belongs to the African race which is in the West Indies.

Tournefort next obtained it, and grew it in the Royal Garden, Paris, handing it on to Hermann in Leiden, who grew it too, and figured it (Paradisus batavus, 1698, p. 230, t.230). In Sherrard's *Schola botanica,* (1689, p. 81) it appeared as *Sinapi indicum maximum Lactucae folio* and also in Hermann's *Paradisus.* Hermann's figure distinctly suggests the African race which is in the West Indies; and the circumstance that Tournefort had journeyed to Lisbon shortly before the name was bestowed, renders it possible that he had obtained the seed from merchants who trafficked between the Guinea coast and the West Indies *via* Lisbon.

In the third place the Upsala Botanic Garden obtained it, apparently from Johann George Gmelin who was employed at the time by the Russian Empress Catherine

upon her survey of Siberia: but we do not find it mentioned in his *Flora Siberica.* Linnaeus observed it between 1742 and 1748 in that Garden with the name *Sinapi sinense, Acanthi folio,* a name which Boerhaave had used in his *Index alter* to the plants cultivated in the Leiden Botanic Garden in 1720. He stated it in his *Hortus Upsalensis* (1748, p. 191), to be Chinese.

The foundation of *Sinapis juncea* in Linnaeus' *Species Plantarum,* 1753, (p. 668) is this plant which was grown at Upsala; and a reference to Hermann's figure was added. In Linnaeus' herbarium a specimen exists. It is not a complete specimen, wanting sufficiently early leaves to show exactly what they were like, and it was dried in its second flowering.

I have already described how after the first flowering new racemes appear in fascicles. Linnaeus observed them, and chose the name " juncea " on account of them. Two detached leaves are upon the sheet, one with a few large teeth, and the other obovate with a double serration. Neither leaf is like those figured by Hermann, so that it is a little surprising that Linnaeus referred to Hermann's figure as illustrating his *Sinapis juncea.* Hermann's figure moreover was not drawn from a plant in its second flowering.

In 1753 Haller claimed to have *S. juncea* growing in the Royal Gardens at Goettingen (Enum. plant. Hort. Reg. Gottingensis, p. 250); and in 1757 Zinn claimed to have it in the University Gardens of the same town (Cat. Hort. Acad. Gottingensis, p. 332). In 1772 Jacquin figured it (Hort. Vindob., 2, p. 80, t.171) from the Vienna Botanic Garden. It is not impossible that the seed had been passed from one garden to another, and that Jacquin's plant represents the race which Linnaeus had. Whether this was the case, or was not, Jacquin's figure seems to have become for most botanists the prototype of the species, for which purpose Linnaeus' description was most inadequate.

But it was not the only race of the species then in European gardens: Linnaeus himself obtained another at an unrecorded date, of which he dried a specimen, and the same race was in the garden of the London Society of Apothecaries, who dried it too, dating their specimen 1759. Linnaeus mislabelled his " chinensis ": then at a later date (the ink differs) crossed " chinensis " out, and substituted " violacea." He meant his *Brassica violacea* (Orychophragma violacea, O. E. Schulz), which is quite a different plant. The Society of Apothecaries called theirs *Brassica foliis infimis ovato-lanceolatis serrato-dentatis, summis linearibus integerrimis.* I have no knowledge whence this race came.

In 1755 Linnaeus defined a *Sinapis laevigata* (Amoen. Acad., 4, p. 281); which remains a doubtful species, and is scarcely the *Brassica laevigata*, Lag. of the Spanish flora. In 1769 the Society of Apothecaries dried another specimen of *B. juncea*, differing from the last and this was labelled *Sinapis laevigata*, Linn. Gouan, who was in charge of the Garden at Montpellier at the end of the 18th century likewise applied this name to *B. juncea*.

Thus confusion commenced.

There is reason to think that Thunberg and Loureiro met with *B. juncea* in the Far East, but confused it with other species of *Brassica*. Thunberg, whose journey occupied the years 1770 to 1779 recorded four mustards as Japanese:—(1) a *B. orientalis*, used for oil-pressing which was not Linnaeus' species so named, *i.e.*, *Conringia orientalis*, Dum. (2) a *S. cerua* to which he attached the Japanese name "takana," (3) a *S. japonica*—"karasi-na" and "karas-na", (4) the turnip, —*B. campestris*, subspecies *B. rapa*. Confining attention to the second, this "taka-na" of the Japanese is *B. juncea;* but Thunberg's *S. cernua* is scarcely *B. juncea* and the result of attaching a wrong vernacular name to what he had before him when drawing up his description has been that those who relied on the name took one plant for *S. cernua*, while others from the characters applied the name to another. He recorded that the Dutch domiciled in Japan used *S. cernua* for a condiment and in doing so he referred doubtless to "takana."

Loureiro who returned to Europe about the same time as Thunberg, but after a much longer residence in the East, published his *Flora Cochinchinensis* in 1790; and (pp. 399—400) described the mustards of Tonkin as three:—(1) the "'kiai tsai" of the Chinese, or "cai cu" of the Tonkinese, which he called *S. chinensis*, with varieties called by the Tonkinese "cai sen" and "cai mo"; (2) *S. pekinensis* and (3) *S. brassicata*. "Cai sen" and "cai mo" are evidently *B. juncea*, as Loureiro suggested, adding that they might also be *S. cernua*, Thunb: the others are different cultivated forms of *B. campestris* sub-species *B. chinensis*, which will be dealt with later: but the name "chinensis" demands a paragraph.

Linnaeus had described a *Brassica chinensis* and a *Sinapis chinensis*. The latter we now call *B. tournefortii*, Gouan. It was said by Linnaeus to be Chinese, but in error: he had received the plant from Arduino who was in charge of the Public Garden in Padua, and Arduino had figured it as *Sinapis siliquis glabris subarticulatis divaricatis*, etc., in his *Animadversiones botanicae* (1759, fig. 10, opposite p. 23). Linnaeus referred to this figure, and moreover preserved a specimen which is in his herbarium.

These together prove beyond any doubt that *Sinapis chinensis* is the Mediterranean *B. tournefortii.* Loureiro when he had before him *Brassica chinensis,* made the error of writing it down in his Flora as this *Sinapis chinensis* which is *B. tournefortii.* In 1812 Stokes made matters worse, for in his *Botanical Materia Medica* (3, p. 480) he took Loureiro's statement for a foundation, apparently went to a little trouble in order to get to know *Sinapis chinensis,* not only recognising that it was in cultivation at Kew, but procuring a specimen for himself from Paris, and then gave to Loureiro's "cai sen" and "cai mo" which are *B. juncea,* the name of *Sinapis chinensis,* var. *integrifolia,* showing clearly that he had not realised what they are; for no botanist can reasonably hold them to be a variety of *B. tournefortii.*

From Loureiro's time to 1860 *B. juncea* received a new name whenever its known range was extended. Vahl commenced by applying the name *S. integrifolia* to a plant which Hans West had brought from the island of Sainte Croix in the West Indies: this name West published in his *Bidrag til Beskrivelse over Ste Croix* (1793, p. 296) with a reference to Sloane's figure which Linnaeus had referred to *S. juncea,* evidently holding it to differ from *S. juncea.* Ten years later Willdenow figured (Hort. Berol., plate 14, published in 1803, but dated wrongly) what he also called *Sinapis integrifolia,* a mustard from the East Indies. Schultes stated in his *Observationes botanicae* (1809, p. 132) that this same *S. integrifolia,* Willd. had been sent to him in Cracow by the Hungarian botanist, Kitaibel.

Besser, who was a professor at Chemnitz at that time, visited Cracow, and found on the hills and in the fields near the town a mustard which he regarded as a separate species and described as *S. campestris* (Prim. Flor. Galic., 2, 1809, p. 88) not intending to suggest any identity with *B. campestris,* Linn. Besser's intimate friend Andrzieowski proposed to rename it *Brassica besseriana,* but did not publish this: he left in his herbarium a label which reads "Brass. Besseriana, Andrz. (Sinap. campestris, Bess. Prim. Fl. Galic.)," and Besser left in his a label which reads "Sinapis campestris, mihi—Brassica, Andrz, –e Galicia." Besser's label at Kew is unfortunately attached to a wrong plant. If no type of his can be found, Andrzieowski's plant will serve. Trautvetter described it in 1860 (Bull. Soc. Imp. Nat. Mosc. 33, pt. 1, p. 135). Russian botanists attach the name to plants very like that which Jacquin figured, but also to rather unlike plants,—all however *B. juncea.*

Roxburgh was responsible for three synonyms, by giving specific rank to varieties which he found cultivated in India, and studied alive in the Honourable East India Company's Botanic Garden at Calcutta. One of these was *S.*

*ramosa*, a form grown for oil. Fleming published a short description of it from Roxburgh's pen in 1810 (As. Res. 11, p. 179). The other two forms were vegetables of the Himalaya, which Buchanan-Hamilton had met with, and seed of which he had procured for Roxburgh. In Roxburgh's *Hortus Bengalensis* (1814, p. 48) they are named *S. rugosa* and *S. cuneifolia*, and are described in his *Flora Indica* (3, 1832, pp. 119-124). He described also a wild *S. patens* which has characters like the common African form.

At the end of the 18th century a French exploring expedition had visited the island of Timor and *B. juncea* was collected there. The specimen became the type of *S. timoriana*, A.-P. de Candolle describing it in his *Regni Vegetabilis Systema* (2, 1821, p. 616) and Delessert figuring it in his *Icones selectae* (2, 1823, t.88). Apparently no lower leaves were collected: but Forbes collected *B. juncea* again in Timor during the last century, and as far as it is possible to judge, *S. timoriana* scarcely differs from the "rai" of India.

A.-P. de Candolle was responsible also for making a new species out of the West Indian plant which Hans West had obtained, calling it *S. lanceolata* (op. cit. p. 611). He added two localities, and suggested that Willdenow was responsible for the name "integrifolia."

Exploration in Africa added the next names. Schimper's long sojourn in Abyssinia from 1836 forwards, resulted in the sending of seeds to several Botanic Gardens; and from him the Garden at Carlsruhe received a race of *B. juncea*, which when grown served for the description of *B. carinata* by A. Braun (Flora, 24: 1841, p. 267). Braun quoted Schimper as stating that the leaves made a vegetable, and remarked that the yield was small; but probably his crop was not grown under the best conditions.

From 1839 to 1843 France had a mission in the same country, and Quartin-Dillon, who was a member of it, sent seed to Montpellier, where Raffenaau-Delile, who was Professor, grew plants which he named *B. dillonii;* but he did not publish the name as he seems to have realised that he was forestalled by A. Braun with the name *B. carinata* (teste Thellung in Verhandl, bot. Vereins Brandenburg, 50, 1908, p. 154). But Touchy (in Bull. Soc. Bot. France, 4, 1857, p. 627) on finding *B. juncea* as an adventive plant near Montpellier and identifying it with *B. dillonii*, published his observation, inadvertently under the name *B. dillenii*. However, Abyssinia is an unlikely source for an adventive plant near Montpellier, and probably *B. dillenii* is not the same variety of race as *B. dillonii*.

Boissier in 1842, with a Muscat specimen before him, collected by Aucher, gave the name *B. willdenowii* to it, intending to indicate that he was dealing with *S. integrifolia,* Willd. (Ann. Sc. Nat., ser. 2, 17, p. 88).

In 1856 Steven in his *Verzeichniss der auf der Tauris-chen Halbinsel wildwachsenden Pflanzen* (p. 73) gave the name *B. laevigata* to a plant which he had found, and suspected of being *S. laevigata,* DC. This plant may be *B. juncea;* but the Fedschenkos in their Flora of Russia in Europe (1910, p. 463) question its status.

Lange, who had met with *B. juncea* as an adventive plant in Denmark, misnamed it *B. richerii* in the first edition of his *Haandbog i den Danske Flora* (1851, p. 338), and in the second (1856, p. 447) took for it the name *B. lanceolata,* and as such figured it in Oeder's *Flora Danica* (15, t.2658). An examination of this figure suggests that it was a race from the Near East, and not the West Indian plant which DeCandolle had called *S. lanceolata,* the identity of the specific names being an accident.

In 1856 Cosson dealing with an adventive plant found near Montpellier (Bull. Soc. Bot. France, 6, p. 609) and Czerniaew listing the plants of Charkow in Russia (Consp. plant. Charkow., p. 8) independently proposed to transfer *S. juncea* to *Brassica,* with the name *B. juncea.* No one knows which author published first, and it is right to quote it as *Brassica juncea,* Coss. aut Czern.

The next event in the history of our species, was the recognition of its polymorphy by Hooker and Thomson (Journ. Linn. Soc. 5, 1861, p. 170), and the reduction of nine of its synonyms to eight correctly. Since then only two new names have been proposed,—*B. dentata,* Watt, and *B. urbaniana,* O. E. Schulz.

*B. dentata* was founded upon depauperate plants gathered in Manipur, which as Sir David Prain has shown (Bull. No. 4, Dep. Land-Records and Agriculture, Bengal, 1898, p. 13) have all the characters that one would expect, should such a vegetable as the " pasai " run wild.

*B. urbaniana* as first described (O. E. Schulz in Urban's Symbol. Antill. 3, 1903, p. 511) on *Eggers* 5141 from Cuba, is the West Indian form of *B. juncea,* which Vahl called *S. integrifolia* and DeCandolle *S. lanceolata.* The second specimen cited (Buch from Haiti) I have not seen. As a synonym *Sinapis chinensis,* Linn. was quoted. Thellung followed, and because *Sinapis sinensis,* J. F. Gmelin (Linn., Syst. Nat., ed. 13, II–2, 1791, p. 989) is, and *Sinapis tenella,* Moench (Meth. 1794, p. 253) is supposed to be *S. chinensis,* Linn., logically added these. But he evidently was in some doubt. Dr. O. E. Schulz, returning to the

subject, in 1919 (in Engler's Pflanzenreich, Cruciferae-Brassiceae, iv–105, p. 59), absorbed Thellung's work, and added to the species a Chinese plant which Fauvel had collected at Chefoo, citing Franchet. But neither the names *S. chinensis,* Linn., *S. sinensis,* J. F. Gmelin, nor *S. tenella,* Moench (presumedly), nor Fauvel's plant belong to *B. urbaniana;* for the first two names belong to *B. tournefortii,* and if Franchet is correct in identifying Fauvel's plant with the Japanese mizu-na, it is what Professor L. H. Bailey has named *B. nipposinica.* Professor Bailey has come near to dissociating *Sinapis chinensis,* Linn. from the species in confusion with it, but has not been able quite to reach the end (Gentes herb., pt. 2, 1922, p. 93).

It is necessary next to return to Thunberg's *S. cernua,* and the plant which is called "taka-na" by the Japanese. The tallest mustard in the fields in Japan is it—(taka means tall) ; it is also known as "o-garashi" ("o" meaning big, to distinguish it from other mustards which are called karachi). It is a race of *B. juncea* not answering to Thunberg's description of *S. cernua,* but certain Japanese botanists relying on the vernacular name have applied *B. cernua* to it. Siebold without doubt intended it by his name *Sinapis chinensis,* var. *takana* (Verhandl. Bataviaash Genootsch. 12, 1830, p. 52). On the other hand it is scarcely possible from his paper just quoted to be sure what he meant by *S. chinensis* var. *karasi.* Miquel (in Ann. Mus. Bot. Lugd.-Bat., 2, 1865, p. 75) apparently used the name *S. integrifolia,* Willd. to cover "taka-na", but he called it "karasi." His *S. cernua* was another plant, likewise "karasi", but with a second vernacular name which he mis-spelled as sjakosi lakano. Hemsley thought that he detected *S. cernua* in specimens distributed from St. Petersburg as of a cultivated plant raised in Pekin by a Russian collector named Skatschkoff; but it is a short-podded plant which he had, the pods with few seeds like *B. alba;* therefore his *B. cernua* (Journ. Linn. Soc. Bot. 23, 1886, p. 47) is the third of this name. Further *B. juncea* in another variety is *B. cernua,* var. *chirimenna,* Makino, in the 1912 edition of the *Somoku Dusetzu.*

Thunberg's *S. japonica* has been taken, now for one species, now for another. Miquel (loc. cit.) thought it perhaps *S. chinensis,* Linn. Franchet and Savatier (Enum. plant. Jap. 1, 1875, p. 38) stated it to be this species: Siebold thought he recognised it and sent seed to Leiden, but excluded it from his paper which has been quoted (see Miquel, in loc. cit. p. 74) :—Dr. O. E. Schulz has made it into *B. nigra,* var. *japonica:* and Professor L. H. Bailey into *B. juncea,* var. *japonica.*

*B. japonica,* Makino, in his edition of the Somoku Dusetzu 1912, 12, plate 33, is not intended to be the same plant, but is *B. nipposinica,* L. H. Bailey.

This completes the assembling of the specific names which have been given to *B. juncea:* and it is time to suggest which should be retained and used varietally.

Certainly the first thing in doing this is to determine the primitive *B. juncea* on which man worked to obtain his cultivated forms. Is it possible to do so?—not quite satisfactorily. But it is possible to set aside the races which are the more highly selected, *e.g.*, the leaf-yielding races, and the oil-seed races.

Sir David Prain in his account of the Indian mustards in the *Bulletin No. 4 of the Department of Land Records and Agriculture, Bengal,* p. 47, divided *B. juncea* sensu latissimo, into two subspecies:—subsp. *B. juncea* in a narrower sense, with varieties based on *S. patens,* Roxb. and *S. ramosa,* Roxb. and subsp. *B. rugosa,* with varieties based on *B. dentata,* Watt, *S. rugosa,* Roxb., and *S. cuneifolia,* Roxb. This scheme is logical if *S. patens* be regarded as derived by reversion from *S. ramosa.* But to my mind it is too like the wide-spread and often (if not usually) wild plant of tropical Africa, for such a view to be fully acceptable. Alternatively then it is primitive, and if so may be held to be as nearly related to the three forms which are put together in the subspecies *B. rugosa,* Prain, as to the variety based on *S. ramosa* (*i.e.*, var. *oleifera,* Prain). I accept the alternative and abandon the subspecies.

Thellung in the *Verhandlungen des botanischen Vereins der Provinz Brandenburg,* 50, 1908, p. 152 divided *B. juncea* into three subspecies, (1) *eu-juncea,* (2) *integrifolia* and (3) *urbaniana.* In as much as the third is more or less *S. patens,* the scheme merits consideration; but the definitions given will not meet the case, as his character derived upon the quantity of hair present runs quite counter to the character based on duration of the lower leaves, which undoubtedly is a good one. It is interesting that on p. 158 Thellung showed an uncertainty regarding *B. urbaniana,* which was due to a partial detection of the errors which, as has been explained, had got into its synonymy: he suggested its right to be called a species.

Dr. O. E. Schulz in Engler's *Pflanzenreich,* tom. cit. takes Thellung's subspecies for species, and adds a fourth as *B. cernua.* He abandons Thellung's use of the hairs as a diagnostic character, substituting one upon the size of the fertile and the sterile parts of the siliques. Of his *B. integrifolia,* (based on *S. integrifolia,* Willd. not of Vahl), which is intended to be the same as *B. rugosa,* Prain, he has two varieties:—var. *carinata* founded on *B. carinata,* A. Braun, and var. *timoriana* which is not *S. timoriana,*

DC., but the result of growing to seed a mustard in a climate where seeding is almost impossible for it.* His *B. cernua* is *B. juncea* with crisped leaves.

Professor L. H. Bailey retains *B. juncea* and *B. integrifolia* as species, and places the plant which is *B. cernua,* O. E. Schulz in *B. juncea,* as var. *japonica.* He describes a var. *crispifolia,* connecting the last named with more typical *B. juncea,* and a var. *multisecta,* which is further away from more typical *B. juncea* than var. *japonica.*

All these botanists however, agree in making the outline of the leaf a character by which they partition *B. juncea,*—the first two into subspecies; the latter two into species.

Species I cannot recognise in it: subspecies I mistrust, for surely where man has selected for leaf-characters and where gradations are easily observable, the differences, unsupported as they are by other characters, have not subspecific values. It is better to define a number of varieties. But we ought to seek to establish them on living material and not upon herbarium specimens. At present I group upon the names thus:—

(*a*) leaves rather small, elliptic-obovate, with even serrations, differing in size over the lower half of the stem, and disappearing from the base early. This is presumedly Sloane's plant, and *S. integrifolia,* Vahl. It is *S. lanceolata,* DC., *S. patens,* Roxb., *B. juncea,* var. *agrestis,* Prain, and *B. urbaniana,* O. E. Schulz. *B. carinata,* A. Braun (*B. integrifolia* var. *carinata,* O. E. Schulz) may belong here, but approaches (*c*) below.

(*b*) selected by man for large and relatively persistent lower leaves. Here apparently belong these names:—*S. cernua,* Thunb. only as regards the Japanese name, and *S. chinensis,* var., Lour. and *S. chinensis,* var. *integrifolia,* Stokes. The following certainly belong:—*S. integrifolia,* Willd., *S. rugosa,* Roxb., *S. cuneifolia,* Roxb., *B. dentata,* Watt, *B. rugosa,* Prain, and *B. juncea,* subsp. *B. integrifolia,* Thellung.

(*c*) selected by man for seed-production, under crop-conditions, where the proximity of one plant to another demands leafage raised from the ground towards the light. To this belong *S. juncea,* Linn., *S. campestris,* Besser, *B. besseriana,* Andrz, *S. ramosa,* Roxb., *S. timoriana,* DC., *B. lanceolata,* Lange, *B. juncea,* var. *oleifera,* Prain, *B. juncea,* subspecies *eu-juncea,* Thellung, *B. juncea,* O. E. Schulz: and the following probably belong:—*B. integrifolia,* var.

* Mr. Flippance in his cultivation of the Chinese mustards at my request upon the top of Government Hill, Penang, produced a form, corresponding to *B. integrifolia,* var. *timoriana,* O. E. Schulz, with one-or rarely two-seeded pods.

*timoriana,* O. E. Schulz, and *B. dillenii,* Touchy. The largest leaves of these plants are at least pinnatipartite above with lobules on the petiole.

(*d*) selected by man for crisped and cut leaves. The following names belong:—*B. juncea* var. *chirimenna,* Makino, *B. cernua,* O. E. Schulz, (excluding citations), *B. nigra,* var. *japonica,* O. E. Schulz, *B. juncea,* var. *crispifolia,* var. *japonica,* and var. *multisecta,* L. H. Bailey.

For a better understanding almost all of them require cultivation alongside each other.

*Brassica campestris,* Linn. subspecies *B. napus,* Linn.

" Sawi biji " in my cultures proved to be the most precocious of all the Chinese mustards grown. On a light soil in spring it flowered at the age of one month with the cotyledons still alive at the base of the stem, though becoming yellow. Sown on better soil and later in the year it took a slightly longer time to reach flowering. The leaves did not form a rosette, and were so scanty that a very large number of plants were required to make a boiling. Plants on good soil branched freely from the lower leaf-axils and grew to about 30 cm., before flowers opened. The inflorescences elongated during flowering so as to keep the buds well above the open flowers, but the rate of elongation was much less pronounced than in " sawi hitam ",—*B. juncea.* At the base of the leaf an auricle clasps the stem, and a very few hairs were present on the leaves.

This Chinese mustard agrees closely with the Indian " tori ", which is *Brassica campestris-napus,* var. *dichotoma:* and which is well described in Sir David Prain's account of the Bengal mustards (p. 37). He points out that " tori " represents in India the summer rape of Europe.

A second flowering did not occur.

*Brassica campestris,* Linn. subspecies *B. chinensis,* Linn.

All the mustards which a Malay may call " sawi puteh ", that is, white mustard, belong to this subspecies; but as some are more conspicuously white than others, at times sawi puteh may be used for the whitest only. There is a Chinese name—" pai kiai "—with exactly the same meaning and application.

In the year 1751 Osbeck visited Canton, and recorded in his *Dagbok ofver en Ostindisk Resa* under the date September 2nd* that none of the cabbages which his ship obtained from the shore were headed, which made him to wonder if climate prevented them from heading. He brought seed to Europe and Linnaeus described *B. chinensis* (Amoen. Acad., 1755, p. 280) upon plants raised from it.

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* P.177 of the English edition of 1771.

Linnaeus preserved a specimen which is still in his herbarium, and is undoubtedly genuine. It is ill-grown, and only just at its flowering, but it suffices for establishing the subspecies.

Jesuit missionaries were resident in Pekin at this time, and, as J. C. Hebenstreit tells us (Nov. Comment. Acad. Sci. Imp. Petrop., 8, for the years 1760-61, 1763, p. 331), were in the habit of sending to their friends in Europe seeds of such plants as they found interesting. From them he received in 1756 seed of a mustard which produced plentiful radical leaves so bunched that an observer would regard it at first as a lettuce: out of the midst of these leaves in due time a flowering stem grew with amplexicaul leaves on it. The radical leaves exceeded a foot in length by half a foot in width, and were oblong or obovate, undulate or toothed along the margins: the midrib was *white* on the inner side, an inch wide at the base, and from it *white* nerves branched into the lamina. The flowering stem attained two feet.

In 1768 Linnaeus (Syst. Nat., ed. 12, 3, p. 231) described *S. brassicata,* without giving any indication of the origin of his seed except to state that the plant was Chinese. Its leaves had *white* veins, and they were bunched as those of a lettuce. It is probable that this *S. brassicata* was defined after correspondence with Hebenstreit, and came from Hebenstreit's seed. The name " brassicata " referred to the bunching of the leaves, and is in contrast to " juncea." Of this species there is no specimen in Linnaeus' herbarium.

*S. brassicata* can now be shewn to be conspecific with *B. chinensis.*

In 1790, as already mentioned, Loureiro attempted to define three species of mustard, confusing *B. juncea,* with *B. chinensis* to a certain degree. His other two were *S. brassicata,* Linn. and *S. pekinensis,*—a new species. He described *S. brassicata* as having the petioles of the lower leaves, shining, long, curved and very *white;* and there is no reason to consider him mistaken in the application of the name. He described *S. pekinensis* as having the lower leaves turbinate-ovate, serrate-runcinate, crisped, their petioles more or less flattened, broad, *yellowish,* very thin, sulcate, subamplexicaul. Professor Bailey has identified *S. pekinensis* with a Chinese mustard now becoming popular as a vegetable in the north-eastern of the United States: and I completely endorse his identification. He calls it *B. pekinensis;* but to me it is no more than a variety of *B. campestris* subsp. *B. chinensis;* as is *S. brassicata.*

Loureiro's *S. chinensis,* excluding the varieties which have been dealt with under *B. juncea,* seems to have been some race of *B. campestris-chinensis* inferior in Tonkin as

a vegetable, for he states that it was less eaten. Only a botanist able to study the mustards now grown in Tonkin within the country itself, is likely to be able to clear up this point.

I have arrived at the conclusion that *B. campestris-chinensis,* var. *pekinensis* differs from *B. campestris-chinensis* var. *brassicata* thus:—

> radical leaf obovate finely and doubly serrate, its midrib broad greenish and gradually widened downwards into the broad greenish petiole if one is present, or to the base; lamina very thin, lettuce like.....*pekinensis*
>
> radical leaf with a blade very broadly obovate or even circular, its white midrib abruptly widened and passing into the white fleshy petiole, which may be markedly curved at the base: white nerves run into the lamina .....*brassicata*

Between these two are gradations, showing that it is impossible to regard them as species,—gradations which of course Linnaeus did not know: but I suspect that Hebenstreit had no pure strain, from his remarks upon it. Unfortunately there exists no specimen to which reference can be made.

Linnaeus' specimen of *B. chinensis* is, as said, a badly grown individual: but it seems to be one of the intermediates between *S. brassicata* and *S. pekinensis,* though nearer to the former than the latter. This observation leads to a thought that however impure Hebenstreit's seed was, Linnaeus had received and used for his *S. brassicata* only the extreme and most distinct form from it. That Linnaeus put the one into *Brassica* and the other into *Sinapis* would be astonishing, were it not obvious that he was not precise in describing the flowers of either species.

Loureiro introduced his *S. pekinensis* into Portugal, but it did not thrive. What happened to Linnaeus' or Hebenstreit's *S. brassicata* is unrecorded: perhaps it was soon lost. However, we find Gouan to have possessed in the Montpellier Garden what he regarded as *S. brassicata.* Roxburgh procured it afresh from China, and left a description of it in his *Flora Indica,* as well as a figure which was reproduced by Sir David Prain as plate 10 in his account of the mustards of Bengal. Roxburgh's plant appears to have been something a little short of the most highly selected strain.

After this date we lose sight of both species for a time. Siebold probably knew *S. pekinensis* in Japan, and called it *B. saruna,*—at least the Japanese name suggests this, though Siebold's remark of it "ad oleum exprimendum

rarius culta" is not re-assuring. Grisebach and writers who followed him in work upon the flora of the West Indies misapplied the name "brassicata" to *B. juncea*.

About 1845 the firm of Vilmorin-Andrieux and Co. obtained seed of *S. pekinensis* and *S. brassicata* from China and experimented with these plants in France. Out of the former they selected a pure line culture and put it upon the market. The latter they abandoned after some time. Specimens and figures suggest that they had not received the most modified form of it; but that they had more than one strain. *S. pekinensis* is figured in their *Plantes potageres* (1904, p. 491). M. D. Bois has re-introduced into France one such mustard in recent years.

Professor Bailey has found *S. pekinensis* to be grown not uncommonly in the north-east of the United States, and has cultivated *S. brassicata* from Chinese seed, but not recognised it as such. Instead he has described it as *B. parachinensis* (Gentes herbarum, 1922, p. 102), and has suggested that *S. brassicata*, Linn. should be referred to his restricted *B. chinensis*—a race which he received from China as "yu ts'ai" yields the best and most fragrant mustard oil which is extracted in that country: so that it is now necessary for botanists in China to isolate this race, and tell us in what measure it is a salad or vegetable mustard, and in what measure it serves as an oil seed. Linnaeus' *B. chinensis* undoubtedly was a salad mustard. Professor Bailey admits that he ascribes the name *B. chinensis* (using it in a very restricted way) to this "yu ts'ai" with hesitation because he is uncertain what Linnaeus meant by the name.

Considering *B. chinensis*, Linn. as probably intermediate between the marked extremes of var. *pekinensis* and var. *brassicata*, but that certainty cannot be obtained, it seems to me well to use these names as varietal. My intermediates are sufficiently characterised in the key on p. 101 above.

## COSMOS IN THE EAST.

In 1791 Antonio Jose Cavanilles established the genus *Cosmos* by a description and figure from life of *C. bipinnatus* (Icones et descript. plant., 1, p. 9, pl. 14) which had been brought into cultivation in the Royal Garden, Madrid, in 1789, by means of seed received from Mexico. On a later page of the same work he added to the genus *C. sulphureus* (p. 56, pl. 79), which was also in cultivation in the Royal Garden from Mexican seed; but in describing it, he failed to give the date of its introduction. It is very curious that within a few years his contemporary N. J. Jacquin described both these plants anew as species of *Coreopsis* and figured them from plants cultivated in Vienna, yet neither in exactly the same form as Cavanilles had. *C. sulphureus* was Jacquin's *Coreopsis artemisiaefolia* (Icones plant. rar 3, p. 16 pl. 595, date of the plate uncertain but towards if not in 1793), and *C. bipinnatus* Jacquin's *Coreopsis parviflora* (Plant. rar. Horti Schoenbrunnensis, 3, p. 65 pl. 374, 1798). Jacquin in his *Collectanea* (Suppl. 1796, p. 155) added that the first came from Mexico: the origin of the second he gave as unknown. His coloured figure of the first shows its ray florets to be orange in colour instead of sulphur; his description calling them fulvous. His description and figure of the second shows a small-headed state of *C. bipinnatus* which is well-known now as a wild plant. Persoon in 1807 renamed it *Cosmos parviflorus.*

In 1820 six new species were ascribed to the genus by Humboldt, Bonpland with Kunth (Nova species et genera, 4, pp. 239–242) from herbarium material, one being *C. caudatus.* The others have not been brought to the East and do not interest us. Unlike *C. bipinnatus* and *C. sulphureus, C. caudatus* has never come into cultivation in Europe; whereas those from the time when Cavanilles first examined them, have never gone out of cultivation, as is easily realised on an examination of the numerous catalogues of Botanic Gardens which the first half of the last century produced. Selection work was commenced; and in A. P. de Candolle's *Catalogus Horti Botanici Monspelensis,* 1813, p. 21, of *C. bipinnatus* there were already two varieties, one purple and the other pale-flowered. The small-headed *C. bipinnatus* var *parviflorus* after a time disappeared from catalogues.

Both *C. bipinnatus* and *C. sulphureus* found their way to India, the second it seems much more in the sulphur yellow race than in the orange race (see for instance Voigt's *Hortus Suburbanus Calcuttensis,* 1845, p. 416) and it has run wild existing now in places very remote from European stations. But as evidence for the orange-flowered plant having been in India in the first half of the

last century, there is a specimen preserved by Wight, without further information than " flores rubri." It was probably taken from a garden.

*C. caudatus* has been mentioned as a species which has never been taken to European gardens; but as Merrill shows, it reached the Philippine islands direct from America by Spanish agency (Flora of Manila, 1912, p. 478). It is now found up and down the East. It is, for instance, widely distributed in the Philippines, and common as a weed about Manila where it flowers all the year round. Specimens of it have been seen from Amboina, north Borneo, and western Sumatra. Koorders (Excursionsflora Java, 3, 1912, p. 339) states that it sometimes runs wild in Java. It is cultivated by the Malays, and the Siamese, persisting about abandoned gardens, is in Burma, in northern India, in Mauritius and in the Seychelles. Apparently it has reached these places by transport westwards.

Merrill expresses an opinion (Enum. Philipp. plants 3, 1923, p. 614), that *C. sulphureus* also has been brought into the Philippines direct from America, but at a later date than *C. caudatus;* and he gives for it only one local name—the Spanish name " amarillo " meaning marygold, where he has several vernacular names for the old established *C. caudatus*, two at least referring to its rough snouted adhering fruits. It if very probable that he is right; but all the *C. sulphureus* in India apparently arrived *via* Europe, unless Wight's plant had another history.

In 1895 a very brilliant orange-flowered race was introduced from Mexico into the United States, and subsequently put upon the market under the name " Klondyke." This new introduction which is described in *Garden and Forest,* 8, 1895 p. 484 has brought into many lands a striking flower. It is spreading rapidly and has already run wild in the neighbourhood of some of the southern Chinese towns. When Wilhelm Miller stated (in Bailey's Standard Cyclopaedia of Horticulture. 2, 1914, article Cosmos, p. 862) that *C. sulphureus* was an introduction of 1896, he was referring to this race and had overlooked the century-and-a-quarter old introduction into Spain.

In 1918 Safford connected *C. sulphureus* with the xochipalli or paint-plant of the Aztecs of Mexico (Journ. Wash. Acad. Sci. 8, p. 613). Hernandez, the physician sent by Philip II of Spain to Mexico to collect information on economic plants, had described it in 1570 as then well-known to everybody: its flower moderately hot, of an agreeable odour and taste, comforting the heart, curing maladies of the womb and ulcers, especially such as appear in the mouth, giving a yellow dye for wool, and a paint for

images, which in a certain measure approached red; for making the paint the flowers were boiled in water with alkali and the juice expressed and strained. Hernandez figured the xochipalli plant and in the figure Safford recognised *C. sulphureus:* then he took the juice of flowers of *C. sulphureus,* and found that alkali does intensify the colour. It is now desirable that some one should ascertain if the sulphur-coloured *C. sulphureus* is a race deficient in alkali or deficient in dye. Either is possible: and interesting experiments in genetics suggest themselves.

No writer has as yet recorded that *C. sulphureus* is used for dyeing in the East; and if, as Merrill suggests, the Spaniards at a relatively late date introduced it into the Philippines, probably, just as the British did in India, they took it as an ornamental plant, its tinctorial uses being entirely forgotten. It was otherwise with *C. caudatus.* That species the Spaniards carried across the Pacific because it served on board ship as a vegetable. They carried it, just as they carried *Amaranthus spinosus* and *Opuntia monacantha.* The last named is no longer eaten; but the Amaranth is; and under the name " ulam rajah " the Malays eat the *Cosmos.*

I. H. Burkill.

## CEDRELA IN THE MALAY PENINSULA.

Upon two occasions, and two only, mature Cedrela has been collected in the Malay Peninsula. Both were in 1886. In January of that year Sir George King's collector, Herman Kunstler, found a fruiting tree (his 10403) in a locality recorded as Ulu Bubong,—an unidentified valley apparently not far from the village of Kerling in north-eastern Selangor: and in May Charles Curtis obtained specimens of a flowering tree (his 826) upon Government Hill, Penang.

Kunstler's label states that his tree was 100 ft. high with a trunk 2–3 feet in diameter and with spreading branches. It stood in dense mixed forest at 400—600 feet above sea-level. Curtis' label gives the locality of his tree as close to the bungalow on Government hill at 2,500 feet, above sea-level; and the tree was 70—80 feet high, very large and spreading.

Gamble (Man. Ind. Timbers, 1922, p. 158) records that the average height of trees of a plantation of *Cedrela toona* in Assam 22 years old was 63 feet; and as Cedrelas grow fast it is not necessary to allow a greater age than 50 years to those which Kunstler and Curtis found.

Gardens Bulletin, S.S.

Both specimens were referred to *C. febrifuga*, Blume, by King (Journ. As. Soc. Bengal, 64–2, 1895, p. 89) and Mr. Ridley has followed him (Flora Mal. Penins. 1, 1922, p. 415). But Casimir de Candolle in 1908 determined Curtis 826, (as represented in the herbarium of the Royal Botanic Gardens, Calcutta—namely by a specimen examined by King.) to be *C. toona*, var. *pilistaminea* (Rec. Bot. Survey, Ind., 3, 1908, p. 366). In the same publication he quoted King as authority for the occurrence of *C. febrifuga* in Penang; that is to say he inadvertently called Curtis' specimen by both names.

There are four species of Cedrela which so occur in nature that to find them alive in Malaya would not be a matter of surprise.

They are:—

*Cedrela toona*, Roxburgh ex Rottler in Ges. Naturforsch. Freunde. Neue Scriften, 4, 1803, p. 198 (little more than the name) and Plantae Coromand., 3, 1819, p. 34.

*Cedrela sureni: Swietenia sureni*, Blume, Cat. Gewassen Buitenzorg, 1823, p. 72: *Cedrela febrifuga*, Blume, Bijdrage, 4, 1825, p. 180.

*Cedrela sinensis*, A. L. de Jussieu in Mem. Mus. Paris, 19, 1830, p. 255.

*Cedrela serrata*, Royle, Illustr. Flora Himalaya, 1839, p. 44, pl. 25.

*C. toona* is the very valuable Toon tree of the forests of India. It is found in the Himalaya up to 4,000 feet, and southwards in the hills of the Peninsula, on the one hand, and on the other through Chittagong to Burma and to the hills in the north of Siam, south of which in a wild state it ceases apparently to grow, but re-appears in northern Australia in a curious way.

*C. serrata* is another Himalaya tree, growing up to 800 feet and extending to Manipur and northern Burma.

*C. sinensis* is a highly valued tree of China, which is wild in the hilly provinces, and exploited for timber, while cultivated elsewhere and often then pollarded because the Chinese eat the tender shoots. Rehder and Wilson (in Sargent's Plantae Wilsonianae, 2, 1914, p. 156) state that in woodlands it is a tall straight tree with a narrow head.

Valeton, Hochreutiner and some others have reduced *C. serrata* and *C. sinensis* to one species; but the differences are sufficient to separate them either varietally or specifically.

*C. sureni* is common throughout Java from sea-level to 4,500 feet, and less abundant upwards to 6,000 feet (Koorders, Excursionsflora Java, 2, 1912, p. 437). It seems to occur also in Sumatra and in Indo-China. Formerly the Philippine *C. calantas* (Toona calantas, Rolfe and Merr.)

was united to it, but on account of larger fruits is now separated: while certain equally large fruited Assam plants remain united to it, but perhaps not logically. These in their seeds, curiously winged at both ends, differ strikingly from the species mentioned earlier. Equally they are valuable timber.

Man by planting has extended the natural range of all four; for instance *C. serrata* is very common in Java not only by European agency but in native holdings; and *C. toona* occurs.

A word must be said upon the occurrence of the last in Java. Hiern (in Hooker's Flora of Brit. Ind. I, 1875, p. 568) credited it to the island: but others have thought that he did so mistaking *C. sureni* for it. This was not so; for Hiern had access to a specimen of *C. toona* collected in Java by Horsfield between 1802 and 1819 and to another collected by Spanoghe who was there for some time prior to 1834. Both men has marked leanings toward economic botany and interested themselves in cultivated plants. Their *C. toona* was doubtless cultivated and Hiern was wrong only in thinking it wild.

*C. toona* was much experimented with in the Straits Settlements by Cantley during the years 1880 and 1888 when he was in charge of the Botanic Gardens, Singapore, and planted in several places. Undoubtedly it will grow in the Peninsula.

Examination of Curtis 826 confirms Casimir de Candolle's determination. It is *C. toona.* And the situation in which Curtis found it gives as complete support as we shall ever get to the view expressed by Mr. Ridley that it is an introduction. But some European probably introduced it in the thirties or forties of the last century, not a Tamil.

Examination of Kunstler 10403 shows it to be *C. sureni* and the situation indicates that it was wild. Therefore the Malay Peninsula is within the natural distributional area of this valuable tree.

The record under *Cedrela* in the Flora of the Malay Peninsula has to be divided into two: the introduced Penang plant is to be recorded under *C. toona;* the rest is to remain as a native tree but by the laws of priority in nomenclature the combination *Cedrela sureni* is to be substituted for *C. febrifuga.*

An immediate duty is to seek in Selangor and elsewhere for more of the valuable tree. My duty in the end of this note is to thank Mr. C. C. Calder, Director of the Botanic Survey of India, for the kindness that he did in giving me information regarding specimens preserved in the Royal Botanic Gardens, Calcutta.

I. H. Burkill.

## BLAINVILLEA, Cass.

Blainvillea, Cass. is a small genus of tropical weeds, found all round the world, chiefly in the somewhat drier parts. One species—B. latifolia, DC.—is very common in Upper India, extending thence to Ceylon, but absent from the wet plains of Lower Bengal, appearing however in the hills of Assam, northern Burma and south-western China. It has been reported from Java; but the report needs confirmation.

In the Journal of the Royal Asiatic Society, Straits Branch, No. 30, two Malay vernacular names—" katumbit padang " and " tutup bumi padang "—are ascribed to it, and a third, " salamani " is ascribed to *B. rhomboidea*, Cass. which is but a synonym. Wilkinson has entered two of them into his Malay Dictionary, correcting the first to " Ketumbit padang." But when the source of the name is sought, it is learned that all three were obtained in Malacca by Cantley's collector, Alvins, and belong to specimens, not of *Blainvillea latifolia*, but of *Synedrella nodiflora*, Gaertn. Nor can evidence be found that the genus *Blainvillea* has yet had any representative in the Malay Peninsula.

I. H. Burkill.

# SOME MALAYAN ORCHIDS, II.

With Plates I—IV.

*By C. E. Carr.*

The plants included in the present paper were collected on Gunong Tahan and on the Tahan and Teku rivers during the latter part of August and the beginning of September, 1928. A number of plants judged to be of special interest were brought back and put into cultivation at Tembeling, Pahang, since that district is more favourable than the drier climate of Singapore. Some of these plants prove to be hitherto undescribed.

The plants dealt with here include only those not previously found in the Tahan river or on the mountain itself, or those which, though reported before, possess any features of interest as yet unnoticed.

Plants marked with an asterisk have already been reported from the district.

**Oberonia subnavicularis**, King in Journ. As. Soc. Beng. LXVI. ii. 579: Ridl. Mat. I. 16; Fl. Mal. Pen. IV. 14. This rare plant, of which there were no examples in the Singapore herbarium, has only once been previously reported, namely by Scortechini from Perak. It was found on a tree overhanging the Tahan river at Kuala Teku, at an altitude of about 500 feet, No. 20809.

Upper sepal pale rose-white, laterals transparently pale yellowish. Petals transparently pale rose. Lip dark red-brown. Endemic.

Flowered in Nov.—Dec., 1928, and Mar.–April, 1929.

**Oberonia 'ampongensis**. J. J. S. in Bull. Jard. Bot. Buit. Ser. 2. XXV (1917) 22. This plant is new to the Peninsula. It was found on a tree by the Teku river at Kuala Teku, at an altitude of 500 feet. Distribution:—Sumatra.

Flowered in January, 1929.

**Liparis** (*Section Rachidibulbon*) **purpureo-viridis**, Burkill, mss.; Ridl. Fl. Mal. Pen. IV. 21. This plant, only previously reported from the main range at Fraser Hill, was found in a colony of about a dozen plants growing on the ground among damp rotting leaves near a tributary of the upper Teku at about 4500 feet altitude. No. 20753. It was just coming into flower but from Fraser Hill I have had it in flower in March. Endemic.

**Liparis** (*Section Coriifoliae*) **lacerata**, Ridl. in Journ. Linn. Soc. XXII. 284; Mat. I. 24; Fl. Mal. Pen. IV. 22. On a tree overhanging the Teku river at Kuala Teku, altitude 500 feet. Distribution:—Tenasserim, Borneo.

Flowered April, 1929.

**Dendrobium** (*Section Sarcopodium*) **citrino-castaneum,** Burkill in Gard. Bull. S.S. III. 12 (1923); *Sarcopodium citrino-castaneum,* Ridl. Fl. Mal. Pen. IV. 29.

This was originally described by Burkill from a plant found near Johore Bahru. On this occasion it was found on trunks of large trees and the branches of small trees beside the Tahan river at Kuala Teku, altitude 500 feet. Endemic.

Flowered January to April, 1929.

**Dendrobium** (*Section Desmotrichum*) **pallidiflorum,** Ridl. in Journ. Linn. Soc. XXXII. 240.; *Desmotrichum pallidiflorum,* Ridl. Mat. I. 37; Fl. Mal. Pen. IV. 31. Trees overhanging the Teku river at Kuala Teku at 500 feet altitude.

Distribution:—Siam and Sumatra.

**Dendrobium** (*Section Aporum*) **quadrilobatum,** Carr in Gard. Bull. S.S., V. (1929) 4. A single plant was found growing together with *D. rhodostele,* Ridl., which was locally abundant, on a tree overhanging the Tahan river at an altitude of about 400 feet. Endemic.

* **Dendrobium** (*Section Distichophyllae*) **Hosei,** Ridl. in Trans. Linn. Soc. III. 363; Mat. I. 46; Fl. Mal. Pen. IV. 43. This plant was found on trees overhanging the Tahan river, as originally found, at an altitude of about 350 feet. It occurs also on other tributaries of the Tembeling river.

A number of plants were brought back and of the six inflorescences so far observed five were one-flowered, the other bearing two flowers. The sepals and petals on opening are greenish, turning however to pale ochre-yellow; the claw of the lip is white, the side lobes ochre-yellow veined orange, while the midlobe is yellow with 3 elevate orange main nerves and about 4 short elevate orange nerves on each side. The nerves are much paler when the flower opens and sometimes brownish in colour, while the whole lip is somewhat greenish yellow.

Plants may occasionally be found producing flowers with three anthers, the lateral ones reaching various stages of development. When a complete 1-celled lateral anther is formed its position on the side of the column and below the rostellum permits the 2 pollinia to gain contact with the stigma in the same manner as in *D. pandaneti,* Ridl. and fertilization ensues. The extent of dehiscence of sepals and petals varies from flowers hardly open to those fully expanded.

**Dendrobium** (*Section Distichophyllae*) **Hosei,** Ridl. *var.* **Pelor,** *var. nov.* Caules foliaque plantae typicae similia: Flores monstruosi. Labellum integrum aut inconspicue

3-lobulatum. Gynostemium breve, ventre lamella triangulari antheram superante donatum; stigma apicale, profunde conico-excavatum. Pes gynostemii brevissimus.

Stems, leaves, inflorescence, upper sepal and petals similar to type. Lateral sepals narrower than upper sepal, mentum very short straight. Lip adnate to apex of column foot, entire or inconspicuously 3-lobulate, very shortly clawed, irregularly obcuneate, apex produced to a short fleshy conic acute papillose point, in upper ¾ papillose towards margins and apex with an elevate median keel, margins erect undulate ciliolate denticulate, inside concave, 3-nerved with outer nerves branched, yellow-green, c. ·67 cm. long, c. ·60 cm. wide. Column short, monstrous, margins slightly elevate, a large lamella in front, lamella erect triangular sometimes dentate and ciliolate exceeding the anther, wings oblong truncate exceeding the anther elevate on back in a broad flattened keel produced at apex to an oblong truncate lobe, the whole c. ·37 cm. long to apex of wings; stigma apical, deeply conico-excavate. Column foot very short making a right angle with the column, margins elevate in the form of keels. Anther filament short, broad, oblong, truncate.

This curious peloric form occurs with the type plants. In the structure of the column it very closely resembles *D. tetrodon*, Rchb. f., *var. Pelor*, J. J. S. Common to both is the curious lamella on the face of the column occupying the normal position of the stigma. This lamella effectively prevents pollination in the manner common to the genus by almost completely covering the rostellum. The flower appears always to be self-fertilized, pollen tubes being emitted by the pollinia in situ from above.

Described from growing plants.

**Dendrobium** (*Section Distichophyllae*) **pahangense**, *sp. nov.* Rhizoma breve, repens. Caules approximati, erecti. Folia c. 10 lanceolata vel oblongo-lanceolata, subobtuse biloba. Inflorescentiae brevissimae, 1-florae. Sepala oblonga acuminata, acuta, lateralia falcata, mento gracillimo lineari acuminato anguste obtuso. Petala subfalcate linearia, acuminata, acuta. Labellum 3-lobum, unguiculatum; lobi laterales minimi, triangulares, apici rotundati; lobus intermedius spathulatus, apici in acumen productus, carinis 3 apicem attingentibus; unguis anguste linearis. Gynostemium rectum, alis in dentem productis. Anthera cucullata, rostro brevi, filamento longiore. Pollinia 4 anguste ovoidea.

Rhizome short, creeping. Stems approximate, erect, leafy above, c. 21 cm. long or longer, basal internode prostrate subglobose, c. 4 internodes above base slender terete dilate upwards and covered with dry tubular sheaths yellow-green up to c. 1·25 cm. long, a dark brown ring on

the node, upper internodes up to c. 46 or more swollen stout terete sinuous c. 4-grooved, entirely covered with dry sheaths yellow-green up to c. 1·25 cm. long, c. ·45 cm. diam., a dark brown ring at the nodes. Leaves up to c. 10 from the upper nodes, vertically spreading, twisted above base, lanceolate or oblong-lanceolate, apex subobtusely bilobed, thinly coriaceous, above shiny bright green, grooved, below opaque paler keeled, c. 1·75 cm. long, c. ·60 cm. wide, sheaths tubular many-ribbed c. 1·25 cm. long on back, in front divided up to c. ·90 cm. long yellow-green soon drying. Inflorescences from base of internodes in upper ¾ of stem, very short, 1-flowered. Bract very small, appressed to pedicel, broadly triangular, obtusely apiculate, margins slightly rounded, inside deeply concave, outside highly convex, pellucidly pale greenish with a conspicuous pale orange median keel, c. .12 cm. long, c. .18 cm. wide. Flowers strongly expanded, scentless, lasting a few days. Sepals and petals white. Upper sepal reflexed above base, almost erect, oblong, acuminate, acute, 3-nerved, inside convex, outside concave, margins slightly reflexed, c. ·70 cm. long, c. ·28 cm. wide. Lateral sepals spreading, falcate, oblong, acuminate, acute, 5-nerved, margins a little reflexed, the anterior margins connate at base for c. ·10 cm., inside convex, outside concave, c. ·80 cm. long, c. ·28 cm. wide, anterior margin dilate at base to the mentum, mentum very slender, porrect, linear acuminate, narrowly obtuse spurlike slightly incurved, scarcely dilate on back, whitish c. ·60 cm. long. Petals subfalcately linear, acuminate, acute, 3-nerved, margins erosulous, inside convex, outside concave, c. ·70 cm. long, c. ·18 cm. wide. Lip adnate to margins of column, 3-lobed, clawed, base and side lobes excepted entirely verrucoso-rugose, blade between side lobes grooved, including claw c. 1·80 cm. long; side lobes very small, horizontal, triangular, margins and apex rounded, whitish; midlobe shortly and broadly spathulate, produced at apex to a short triangular point, margins incurved undulate crenate, pale yellowish, keels 3 reaching the apex, orange at base greenish-ochre above, c. ·60 cm. long and as broad; claw narrowly linear, inside concave, whitish, c. ·65 cm. long. Column straight, narrowed towards apex, flat in front, rounded on back, wings produced to a falcately triangular acute recurved tooth as long as the anther, a minute globose tubercle below rostellum, whitish often suffused pale orange, in front below the stigma a median groove with an orange spot on each side, in all c. ·45 cm. long; clinandrium semilunate, deeply conico-excavate; stigma excavate, oblong, narrowed towards apex. Anther cucullate, biloculate, grooved at base, papillose, orange, very shortly hairy towards apex, beak short truncate white shortly hairy and ciliolate, seen from above subquadrate, c. ·11 cm. long, filament rather long subulate. Pollinia 4, narrowly ovoid, flattened inside, yellow, c. ·09 cm. long.

Column foot linear, narrowed towards apex, c. ·65 cm. long. Ovary whitish c. ·45 cm. long, pedicel as long greenish-white.

A plant of this was found growing with the allied *D. rupicolum*, Ridl. on a tree on Skeat's Ridge at an altitude of about 5000 feet. It flowered in March 1929. During the same month it was also found by me in flower on Fraser Hill at an altitude of about 4000 feet. Here also it grew in conjunction with *D. rupicolum*, Ridl.

Described from living material.

**Dendrobium** (*Section Rhopalanthe*) **planibulbe**, *Lndl. Bot. Reg. 1843 Misc. 54; Ridl. Fl. Mal. Pen. IV. 41; D. tuberiferum, Hook, f. F. B. I. V. 728, Ic. Pl. 2025; Ridl. Mat. I. 48.* Tahan river at an altitude of about 500 feet.

Distribution:—Java, Borneo.

**Dendrobium** (*Section Grastidium*) **salaccense**, *Lindl. Gen. & Sp. Orch. 86; Miq. Fl. Ind. Bat. III. 635; J. J. S. in Fl. Buit. VI.* (*Orch. 1905*) *348, Atlas* (*1908*) *f. CCLXIV; D. intermedium, T. & B. Nat. Tijdsche. Ned. Ind. V.* (*1853*) *490; Rchb., f. Walp. Ann. VI. 288; D. gemellum, Ridl.* (*not of Lndl.*) *in Journ. Linn. Soc. XXXII. 252; Grastidium salaccense, Bl. Bijdr. 355; Callista salaccensis, O. K. Rev. Gen. Pl. II. 655; C. intermedia, O. K. l. c.* Tahan river at Kuala Teku on trees by the river at an altitude of 500 feet. A very fine form with pendulous stems up to 6 feet long. The flowers had a very faint tint of rose. Possibly this may be *var. major* of J. J. Smith.

Distribution:—Java, Sumatra.

**Dendrobium** (*Section Pedilonum*) **serpens**, *Hook. f. Ann. Bot. Gard. Calc. V. 10. Pl. 16; Ridl. Mat. I. 51; Fl. Mal. Pen. IV. 47; D. panduriferum var. serpens, Hook. f. F. B. I. VI. 186.* Tahan river at Kuala Teku on a tree overhanging the river, altitude 500 feet. Endemic.

**Bulbophyllum** (*Section Monilibulbum*) **tristriatum**, *sp. nov.* Rhizoma repens, gracile. Pseudobulbi moniliformes, prostrati. Folium oblongo-ellipticum, acutum. Inflorescentiae erectae, 1-florae, pedunculo longiusculo filiformi. Bractea tubulosa. Flos majusculus. Sepala acuminata, acuta, postico anguste lanceolato, lateralibus anguste oblongo-ovatis. Petala minima, oblongo-oblanceolata, obtusa. Labellum 3-lobum, marginibus super basin in auriculas 2 erectas oblongas rotundatas productis; lobi laterales magni, triangulares, obtusi; lobus intermedius linearis. Gynostemium breve, rectum, stelidiis longis subulatis acutis sigmoidee curvis. Anthera cucullata, transverse oblonga. Pes gynostemii quam gynostemium multo longior. Ovarium clavato-dilatatum, pedicello gracillimo.

Rhizome rather long, slender, creeping, branched, entirely covered with approximate or subapproximate

pseudobulbs. Pseudobulbs moniliform, prostrate, adnate to rhizome, seen from above oblong, flattened on back, minutely longitudinally wrinkled, apex recurved, base surrounded with dry fibres, green, up to c. ·80 cm. long, c. ·40 cm. wide, c. ·30 cm. thick, 1-leaved. Leaf erect, oblong-elliptic, acute, grey-green, up to 2 cm. long, ·40–·70 cm. wide, petiole up to ·30 cm. long. Inflorescences from base of pseudobulbs, erect, 1-flowered, peduncle filiform with a tubular sheath at base, green suffused red, up to c. 6 cm. long. Bract tubular, c. ·15 cm. long. Flower rather large, lasting for several days, scentless. Upper sepal narrowly lanceolate, long-acuminate, acute, margins minutely ciliolate and denticulate, papillose in upper ¼, 3-nerved, 3 conspicuous narrow keels on back, pale yellow with a semitransparent base and 3 short longitudinal dull red striae, c. 2 cm. long, c. ·21–·25 cm. wide. Lateral sepals spreading, running almost to apex of column foot, falcate, narrowly oblong-ovate acuminate, acute, anterior margin slightly dilate at base, papillose in upper ¾, margins minutely toothed and ciliate, 3 narrow conspicuous keels outside towards base, pale yellowish white with 3 dull red basal longitudinal striae, base semitransparent, 2.20-3 cm. long, .23–.30 cm. wide. Petals very small, spreading, oblong-oblanceolate, obtuse, thin, whitish with a broad median dark red stria, c. .25 cm. long, c. .10 cm. wide. Lip adnate to apex of column foot, mobile, fleshy 3-lobed, base erect, above base about rightangularly recurved and deeply concave with margins produced backwards to 2 erect oblong rounded auricles, inside shortly grooved, outside shortly keeled, dull red-purple, spread out c. .50 cm. long, across side lobes c. .25 wide; side lobes large, triangular, obtuse, margins rounded strongly reflexed and revolute, almost contiguous and forming a tube below the lip; midlobe linear, narrowed towards the obtuse apex, margins reflexed and revolute. Column short, broad, straight, produced on back to a large ovate obtuse lobe, dull red. c. ·05 cm. long, wings porrect oblong produced at apex to a long subulate acute S-curved c. ·04 cm. long stelidium; rostellum broad, pale yellow; stigma large, oblong, base convex, excavate above. Anther cucullate, 2-celled, seen from above transversely oblong curved with a median elevation. Pollinia 4 yellow. Column foot much longer than column and forming a right angle with it, apex shortly free slightly incurved and dilate, inside concave with a median keel with a strongly thickened base, dull red, c. ·15 cm. long. Ovary clubbed, green, c. ·12 cm. long, pedicel very slender terete red.

This plant is of the same affinity as *B. cernuum,* Lndl. and *B. Stormii,* J. J. S. from Sumatra. From the short description it also resembles *B. araniferum,* Ridl. but the specimens of this in Herb. Singap. are flowerless and the colour notes in the description differ.

Tahan river at Kuala Teku, altitude 500 feet, on mossy branches of a tree overhanging the river. The flowers close each night, opening again the following morning.

Described from living material.

**Bulbophyllum** (*Section Monilibulbum*) **ignevenosum,** *sp. nov.* Rhizoma gracillimum. Pseudobulbi moniliformes, dorso compressi, dimidio antico recurvi. Folium lanceolatum aut elliptico-lanceolatum, acutum. Inflorescentiae erectae, l-florae, pedunculo filiformi. Bractea infundibuliformis. Sepala oblonga, breviter apiculata. Petala oblongo-oblanceolata vel oblongo-elliptica, acuminata, obtusa. Labellum mobile, inconspicue 3-lobum, lamina sulcata; lobi laterales breves, lati rotundate curvi; lobus intermedius ovatus, obtusus. Gynostemium breve, vix rectum, stelidiis subulatis, rostello breviter rostrato, stigmate oblongo. Anthera vix plana, supra elevata. Pollinia subovalia.

Rhizome creeping branched, very slender, entirely covered with approximate or subapproximate pseudobulbs. Pseudobulbs adnate to rhizome, moniliform, seen from above subquadrate strongly flattened, upper half recurved grooved beneath, densely and minutely wrinkled, pale yellow-green, c. .50 cm. long, c. .40 cm. wide, c. .15 cm. thick, l-leaved. Leaf erect, lanceolate or elliptic-lanceolate, acute, green, up to c. 1.20 cm. long, c. .30 cm. wide, petiole c. .10 cm. long. Inflorescences from base of pseudobulb, erect, l-flowered; peduncle filiform, slightly dilate towards apex, sparsely scurfy, c. 3 tubular sheaths at base, yellow suffused orange, c. 1.60 cm. long. Bract funnel shaped, produced and keeled on back, apex acute. Flower fairly expanded, lasting a few days. Upper sepal oblong, very shortly apiculate, base 3- above 5-nerved, inside concave, outside convex, transparently yellow with flame coloured elevate nerves, c. .30 cm. long, c. .15 cm. wide. Lateral sepals running to apex of column foot, oblong, very shortly acuminate, shortly apiculate, the apiculus sparingly papillose, base 3- above 5-nerved, anterior margin a little dilate at base, transparently yellow with elevate flame coloured nerves, c. .40 cm. long, c. .23 cm. wide. Petals oblong-oblanceolate or oblong-elliptic, acuminate, truncate-obtuse, 1-nerved, margins and apex subsinuate, transparently yellow, median nerve elevate flame coloured, c. .18 cm. long, c. .08 cm. wide. Lip adnate to apex of column foot, mobile, inconspicuously 3-lobed, blade between side lobes grooved, dull red, beneath lower half convex, upper half concave, grooved to apex, spread out c. .26 cm. long, across side lobes c. .22 cm. wide; side lobes short, broad curved, margins erect; midlobe ovate, obtuse, margins recurved, c. .13 cm. long. Column short, nearly straight, yellow, c. .07 cm. long, stelidia subulate as long; rostellum produced

to a short beak; stigma large, excavate, oblong. Anther almost flat, an elliptic elevation above. Pollinia 2 (? 4), suboval, pale yellow. Column foot making a right angle with column, narrowed towards apex, apex itself incurved and dilate. Ovary c. .09 cm. long, pedicel terete thicker than peduncle sparsely scurfy c. .80 cm. long.

Skeat's Ridge at about 4800 feet altitude, forming masses on a mossy tree trunk.

Described from living material.

**Bulbophyllum** (*Section Monilibulbum*) **biseriale**, *sp. nov.* Rhizoma repens, gracillimum. Pseudobulbi approximati, suberecti, conici, obtusi, biseriales. Folium linearilanceolatum, acutum. Inflorescentiae erectae, fasciculatae, 1-florae, pedunculo filiformi. Bractea infundibuliformis. Sepalum dorsale lanceolatum, acutum. Sepala lateralia ovato-oblonga, acuta. Petala linearia, obtusa, superne leviter dilatata. Labellum mobile, 3-lobum, basi profunde concavum marginibus erectis; lobi laterales breves, lati, triangulares, apici truncati; lobus intermedius oblongus, marginibus recurvis. Gynostemium breve, latum, curvum, stelidiis longissimis subulatis, stigmate maximo transverse oblongo. Anthera cucullata. Pollinia triangulari-ovata. Pes gynostemii linearis, apici incurvus. Capsula immatura ovoidea.

Rhizome creeping, very slender, entirely covered with approximate and biserial pseudobulbs, up to c. 3 cm. long or longer. Pseudobulbs conic, obtuse, suberect, apex slightly recurved, longitudinally wrinkled and costate, conspicuously grooved beneath, pale green, ·20–·40 cm. long, ·15–·20 cm. diam., 1-leaved. Leaf erect, often slightly recurved towards apex, linear-lanceolate, acute, thinly coriaceous, above grooved green, beneath paler convex with an inconspicuous median keel, 1–2·25 cm. long, ·15–·33 cm. wide, petiole minute thick grooved up to ·05 cm. long. Inflorescences from base of pseudobulbs, c. 5 from each, fascicled, erect, 1-flowered, peduncle filiform pale yellow-green .75-1.50 cm. long. Bract funnel-shaped, back produced acute, pale greenish, c. .12 cm. long. Upper sepal porrect, lanceolate, very shortly narrowed below the acute apex, 3-nerved, margins roundly papillose except at base, golden yellow, outer nerves elevate on back, c. ·50 cm. long, c. ·17 cm. wide. Lateral sepals adnate to column foot, scarcely spreading, ovate-oblong, acute, 3-nerved, outer nerves branched, posterior margin slightly dilate, margins roundly papillose, golden yellow, nerves outside elevate darker, c. ·55 cm. long, c. ·25 cm. wide. Petals linear, slightly dilate above, apex obtuse, 1-nerved, yellow, c. ·15 cm. long, c. ·02 cm. wide. Lip adnate by an oblong thin lamella to apex of column foot, mobile, 3-lobed, fleshy, above at base deeply concave with

erect margins, above base grooved between side lobes, beneath highly convex at base, orange-red, spread out c. ·27 cm. long, across side lobes c. ·12 cm. wide; side lobes short, broad, triangular, truncate, strongly recurved beneath the blade; midlobe oblong, margins recurved, convex above, concave below. Column short, broad, curved, produced on back to an oblong-ovate subacute lobe, stelidia very long porrect subulate, twice as long as the anther or longer, subsigmoidly curved, yellow, base orange-suffused, c. ·08 cm. long, stelidia as long, rostellum large ovate, stigma very large, deeply excavate, transversely oblong. Anther cucullate, connective long subulate. Pollinia 4, triangular-ovate, laterally flattened, yellow. Column foot linear, apex incurved, orange-red, c. ·10 cm. long. Ovary dilate, 6-sulcate, up to c. ·09 cm. long, pedicel terete pale green ·40–·70 cm. long. Immature capsule ovoid, keels 6 strongly elevate, green, c. 1 cm. long.

Padang woods at an altitude of about 5500 feet, on branches of trees.

Remarkable for the margins of the sepals, which appear, under the microscope, to be fringed with minute drops of liquid.

This plant is, I think, best included in the section *Monilibulbum*, the structure of the flowers, with particular reference to lip and column, being quite in keeping with those members of the section not possessing long acuminate sepals.

The pseudobulbs are adnate to the rhizome only at the base and are almost erect and arranged in two series, whereas in the typical members of the section they are prostrate and moniliform with only the portion below the apex upcurved. The usual median groove on the front of the pseudobulbs is very conspicuous in *B. biseriale*.

Described from living material.

**Bulbophyllum** (*Section Micromonanthe*) **tekuense**, *sp. nov.* Rhizoma repens, gracile. Pseudobulbi moniliformes, ovales, apici leviter recurvi. Folium lineari-lanceolatum aut oblongo-lanceolatum, acutum. Inflorescentiae erectae, 1-florae, pedunculo filiformi. Bractea infundibuliformis. Sepalum dorsale lineare, acuminatum, conico-apiculatum. Sepala lateralia falcate oblonga, brevissime acuminata, subobtusa. Petala basi linearia, fere medio spathulate dilatata, apici abrupte truncata, margine apicali medio rotundate dilatato. Labellum mobile, integrum, oblongum, obtusum. Gynostemium breve, validum, stelidiis subulatis. Anthera cucullata, basi biloba, apici breviter rostrata. Pes gynostemii basi valde incrassatus, apici attenuatus incurvus.

Rhizome rather long-creeping, branched, slender, entirely covered with approximate pseudobulbs. Pseudobulbs adnate to rhizome, moniliform, seen from above oval, slightly

rounded on back, apex slightly recurved, green, c. ·60 cm. long, c. ·30 cm. wide and as thick, 1-leaved. Leaf erect linear-lanceolate or oblong-lanceolate, acute, above grooved, green, beneath paler, 1–1·75 cm. long, ·30–·50 cm. wide. Inflorescences from base of pseudobulbs, erect, 1-flowered; peduncle filiform, dilate towards apex, sparsely scurfy above, an arched tubular sheath at base c. ·30 cm. long, another sheath above base broadly funnel-shaped, produced on back, acute, outside scurfy, c. ·28 cm. long. Bract funnel-shaped, c. ·30 cm. long. Upper sepal porrect at base, about middle recurved, linear, acuminate, apex conic-apiculate, 3-nerved, nerves strongly elevate on back, outside scurfy, c. ·85 cm. long, c. .25 cm. wide. Lateral sepals running almost to apex of column foot, subparallel, falcately oblong, very shortly acuminate, subobtuse, 3-nerved, outer nerves branched strongly elevate outside, anterior margin slightly dilate at base, scurfy outside, c. ·88 cm. long, c. ·28 cm. wide. Petals base linear, about in middle spathulately dilate, apex abruptly truncate, apical margin roundly dilate in middle, c. ·26 cm. long, c. ·17 cm. wide. Lip adnate to apex of column foot, mobile, entire, oblong, obtuse, rather thickly fleshy, base erect, recurved about middle, 3-nerved, entirely densely papillose and minutely hairy, inside in lower ⅔ concave with erect fleshy slightly recurved ciliolate margins, in upper 1/3 convex, outside convex in lower 2/3 with a strongly elevate median keel, margins concave, c. .30 cm. long, c. .12 cm. wide. Column short, stout, stelidia short porrect subulate, rostellum produced to an oblong-ovate obtuse beak, stigma transversely oval. Anther cucullate, base bilobed, apex produced to a short papillose beak. Pollinia 4 unequal, inner ones smaller, yellow. Column foot longer than column, base strongly thickened, apex thin incurved. Ovary and pedicel sigmoidly curved, ovary scurfy c. .30 cm. long, pedicel terete dilate towards apex, scurfy, c. 1 cm. long.

Kuala Teku at 500 feet altitude on mossy branches of a tree overhanging the Teku river. The colour notes were unfortunately lost upon the mountain. Described from material preserved in alcohol.

The plant is well characterised by the curious structure of the petals. It is similar in habit to plants of the section *Monilibulbum* but differs distinctly in the structure of the flowers. The section *Micromonanthe* embraces some very diverse forms and will have to be split when more species are known.

**Bulbophyllum** (*Section Globiceps*) **apiferum**, *sp. nov.* Rhizoma repens. Pseudobulbi approximati, prostrati, ovoidei, apici recurvi. Folium oblanceolatum, subacutum. Inflorescentia erecta, apici dense c. 14-flora pedunculo terete, rachide nutante incrassata. Bracteae late ovatae, acuminatae, subacutae. Sepala oblonga, acuminata, acuta, lateral-

bus marginibus anticis contiguis. Petala oblonga, obtusa. Labellum integrum, oblongo-spathulatum, retusum. Gynostemium breve, alis bilobis. Anthera cucullata, subquadrata, Pollinia 4. Pes gynostemii apici incurvus.

Rhizome shortly creeping, copiously rooting. Pseudobulbs approximate, prostrate, appressed to rhizome, ovoid, apex recurved, wrinkled, dark green, c. 1 cm. long, c. .70 cm. wide, 1-leaved. Leaf erect, oblanceolate subacute, rather thickly fleshy, coriaceous, narrowly grooved above, inconspicuously keeled beneath, dark green, c. 12 cm. long, c. 2.50 cm. wide. Inflorescence from base of pseudobulb, erect, densely c. 14-flowered at apex; peduncle stout, terete, dilate and laterally flattened towards apex, 2 tubular sheaths at base and 2 more above, c. 14 cm. long; rachis incrassate, nodding, making an obtuse angle with peduncle, angulate with concave sides, quadrate in transverse section, c. 1.50 cm. long. Bracts not alternate, appressed to ovary, broadly ovate, acuminate below the subacute apex, margins shortly erose, 3-nerved, inside concave furfuraceous, outside convex warty furfuraceo-punctate conspicuously keeled, c. .35 cm. long, c. .30 cm. wide. Flowers sessile, scarcely expanded. Sepals rather fleshy. Upper sepal continuing the ovary, oblong, shortly acuminate below the acute apex, nerves 5 branched, a shorter nerve on each side, inside concave sparsely furfuraceous, densely papillose in upper half, outside warty furfuraceo-punctate papillose towards margins, margins ciliolate except at base, nerves elevate, c. .67 cm. long, c. .42 cm. wide. Lateral sepals running down to about middle of column foot, horizontally porrect below lip, oblong, shortly acuminate below the acute apex, posterior margin recurved, anterior margins contiguous, margins ciliolate except at base, nerves similar to those of upper sepal, inside densely papillose except at the concave and furfuraceo-punctate base convex towards posterior margin and apex, outside warty furfuraceo-punctate, c. .85 cm. long, c. .47 cm. wide. Petals parallel, oblong, obtuse, thin, 3-nerved, papillose towards apex, margins erose in lower half ciliolate, in upper half, outside very sparingly scurfy keeled, c. .35 cm. long, c. .18 cm. wide. Lip adnate to apex of column foot, entire, oblong-spathulate, shortly retuse, base erect, above base recurved porrect, margins recurved produced at base to a short rounded lobe, above papillose except at base, grooved in lower 2/3, keels 2 from margins above base converging towards apex of median groove convex towards apex, beneath conspicuously keeled in lower 1/3, keel grooved, 3-nerved, outer nerves branched, spread out c. .58 cm. long, c. .42 cm. wide. Column short, wings bilobed, lower lobe triangular obtuse, upper one much longer subulate acute very fleshy with rather erose posterior margin, without wings c. .08 cm. long, wings as long, clinandrium excavate trans-

versely oblong, stigma excavate short broadly ovate. Anther cucullate, 2-celled, rather flat, papillose towards apex, seen from above subquadrate, grooved apex shortly ciliolate, Pollinia 4, yellow. Column foot making a right angle with ovary, inside convex base broad, narrowed towards the incurved apex, c. .35 cm. long. Ovary 6-sulcate, curved, dilate towards apex, furfuraceo-punctate, c. .45 cm. long.

Padang woods at an altitude of about 5,500 feet, one plant only seen. Described from the living plant and an inflorescence preserved in alcohol. Unfortunately the colour notes were lost on the mountain.

**Bulbophyllum** (*Section Sestochilos*) **foetidolens**, *sp. nov.* Rhizoma longe repens, validum. Pseudobulbi dissiti, erecti, anguste cylindrici, lateraliter compressi. Folium linearioblanceolatum, acuminatum, acutum, tenue, petiolo sulcato tortoque. Inflorescentia erecta, dense multiflora, pedunculo terete valido longiusculo, rachide nutante. Bracteae ovatae, acuminatae, acutae. Sepala oblong-lanceolata, acuta, lateralibus falcatis. Petala linear-oblanceolata, obtusa. Labellum mobile, integrum, ligulatum. Gynostemium breve, alis in dentem brevissimum subulatum productis. Anthera cucullata, supra apicem versus in incrassationem conicam papillosam elevata. Pollinia 4, valde inaequalia.

Rhizome long-creeping, covered with dry sheaths, up to c. .45 cm. diam. Pseudobulbs up to c. 6 cm. distant, erect, narrowly cylindric, laterally flattened, longitudinally wrinkled, dark green, up to c. 5 cm. long, c. .60 cm. wide, c. .45 cm. thick, 1-leaved. Leaf linear-oblanceolate, acuminate acute, thin, recurved towards apex, base narrowed to the petiole, grooved above, conspicuously keeled beneath, green, 11-22 cm. long 1.50-3.25 cm. wide, petiole grooved twisted green 1–2.50 cm. long. Inflorescence from base of pseudobulb, erect, densely many-flowered; peduncle terete, stout, some tubular sheaths at base and c. 3 loosely tubular distant acute keeled sheaths above, dark red, up to c. 13 cm. long; rachis nodding, similar in colour, up to c. 5 cm. long. Bracts appressed to pedicel, ovate, acuminate, acute, inside concave, outside convex, green, purple-spotted and suffused, up to c. .40 cm. long, c. .27 cm. wide. Upper sepal oblong-lanceolate, acute, 3-nerved, outer nerves reaching the middle, incurved above middle, inside concave, outside convex, nerves elevate in lower half, semitransparently whitish densely spotted and suffused purple, c. .75 cm. long, c. .30 cm. wide. Lateral sepals shortly running down the column foot, pendulous, parallel, falcately oblong-lanceolate, acute, 3-nerved, outer nerves reaching to about middle, anterior margin roundly dilate from base to about middle, margins incurved at apex, inside concave, outside convex, nerves elevate, whitish densely spotted and suffused purple, c. .75 cm. long, c. .32 cm. wide. Petals strongly spreading, base twisted, linear-ob-

lanceolate, obtuse, 3-nerved, outer nerves reaching to about middle, semitransparently whitish, in upper half and on margins laxly, in lower half densely spotted purple, c. .50 cm. long, c. .10 cm. wide. Lip adnate to apex of column foot, mobile, entire, fleshy, ligulate, curved, margins at base erect, produced on each side to an oblong obtuse lobe, inside concave below middle, above middle recurved convex, sides slightly concave, below convex grooved almost to apex, a short transverse groove above point of insertion, brown-purple, cinnamon colour towards apex, c. .30 cm. long, c. .18 cm. wide. Column short, nearly straight, pale yellowish, inside densely, remainder sparsely purple spotted, c. .18 cm. long, wings produced to a very short subulate tooth, clinandrium excavate transversely oblong, stigma suborbicular. Anther cucullate, 2-celled, a conic papillose projection above towards apex, c. .08 cm. long. Pollinia 4, very unequal, cohering in 2-suborbicular laterally flattened bodies, yellow. Column foot making a right angle with column, obtusangularly incurved in middle, linear, apex produced to 2 very short diverging teeth, whitish densely spotted purple, c. .30 cm. long. Ovary 6-grooved, tumid, furfuraceous, with pedicel sigmoidly curved, dark red, c. .70 cm. long.

Wray's Camp at an altitude of about 3,500 feet.

This is a close ally of **B. densiflorum**, Ridl. As Doctor J J. Smith points out, the original section **Pahudia** cannot be maintained as it was created to embrace those species of the section **Sestochilos** bearing more than one flower on the inflorescence and which, apart from this, agree in every way with the latter section.

**B. maximum**, Ridl. which is included in **Fl. Mal. Pen.** under **Pahudia** should be transferred to the section **Sestochilos**.

Described from a living plant.

**Bulbophyllum dryas**, *Ridl. in Journ. F.M.S. Mus. VI. (1915) 175*; *Fl. Mal. Pen. IV. 62.* Rhizome long-creeping, very slender, covered with dry sheaths, sparsely branching, rooting from the pseudobulbs and more sparsely from the nodes, c. .06 cm. diam., internodes .60-.75 cm. long. Pseudobulbs c. 1.50-2.50 cms. distant, obsolete, minute, disciform, c. .01-.12 cm. long, c. .08-.10 cm. diam., 1-leaved. Leaf suberect or parallel to the rhizome, elliptic-lanceolate, subacute, apex recurved, thickly fleshy, often minutely rugulose, above concave on the median line, convex on each side, shiny dark green, below convex opaque and paler, .75-1.25 cms. long, .60-.70 cm. wide, petiole minute grooved c. .05 cm. long. Inflorescence from base of pseudobulb or from nodes, erect, 1-flowered; peduncle filiform, dilate towards apex, sparsely furfuraceo-punctate, 2 tubular sheaths at base and 1 longer tubular sheath above, c. 2.50-4 cms. long.

Bract infundibuliform, produced on back acute, c. .20 cm. long. Upper sepal lanceolate, shortly obtusely apiculate, above the middle slightly incurved, 3-nerved, inside concave, outside convex, semitransparently yellow, nearly 1 cm. long, c. .45 cm. wide. Lateral sepals running down to about the middle of the column foot, spreading, triangular oblong, obtusely apiculate, 3-nerved, anterior margin above the base slightly rotundately dilate, semitransparently yellow, c. 1 cm. long, c. .47 cm. wide. Petals narrowly spathulate, subacute, 1-nerved, semitransparently pale yellow, c. .35 cm. long c. .18 cm. wide. Lip adnate by a thin lamella to apex of column foot, mobile, entire, above the middle recurved, above the narrow base ovate, narrowly obtuse, margins recurved, above convex on each side of a shallow median groove, below concave on each side of a median keel reaching to about the middle, base and median groove whitish, remainder pale yellow suffused dull red, c. .40 cm. long, c. .26 cm. wide. Column short, stout, slightly curved, whitish, c. .18 cm. long, wings rather wide short broadly triangular obtuse with rounded margins; clinandrium suborbicular, slightly excavate; rostellum very small, oblong, erect; stigma very small, oval. Anther, cucullate, whitish. Column foot linear, forming an acute angle with the column, narrowed towards the apex, apex itself slightly dilate and incurved, c. .27 cm. long. Ovary 6-sulcate, furfuraceo-punctate, c. .15 cm. long; pedicel terete, furfuraceo-punctate, c. .60 cm. long. Capsule ovoid, pendulous, flattened beneath, green, c. .80 cm. long, c. .40 cm. diam.

Upper Teku valley at about 4,500 feet altitude on exposed stunted bushes, in flower. I found this also in flower during March and April 1929 on branches of trees on Fraser Hill at an altitude of about 4,000 feet.

This plant is of interest owing to the very minute pseudobulbs and it appears at first sight as though there were none at all. It clings closely to the substratum and with its small fleshy leaves spaced some distance apart is easily overlooked.

The species cannot be placed in any of the existing sections of the genus, and, having regard to the long-creeping rhizome, the obsolete pseudobulbs and the absence of stelidia I consider a new section should be created and I here propose the name **Aeschynanthoides.** As pointed out by Ridley the plant, when first seen growing on a branch of a tree, somewhat resembles some species of the genus *Aeschynanthus. B. peperomiifolium,* J. J. S. might be best placed here. It occurs in the hills of Java.

**Bulbophyllum** (*Section Epicrianthes*) **papillosofilum,** *Carr in Gard. Bull. S.S. V. 9, pl. V.* A single plant found on a tree overhanging the Teku river just above its mouth, about 500 feet altitude. Endemic.

**Bulbophyllum** (*Section Dialeipanthe*) **Stella,** *Ridl. in Journ. Linn. Soc. XXXI. 297; Fl. Mal. Pen. IV. 96.* Rhizome creeping, branched. Pseudobulbs approximate, quadrilaterally conic, apex slightly recurved, sides slightly concave, rather shinily green, fuscous towards apex, c. 1-2 cms. long, and about as broad, 1-leaved. Leaf oblong-elliptic, shortly acuminate, acute, rather fleshy, apex a little recurved, above obtusangularly concave median nerve depressed, below obtusangularly convex median nerve conspicuously elevate, base narrowed to a petiole, green or yellow-green, 9-13 cms. long, 3-4 .60 cms. wide, petiole grooved green 1-2 cms. long. Inflorescence from base of pseudobulb, erect, very many-flowered, peduncle elongate, terete, thickened towards apex, dark dull purple almost black, some tubular sheaths at base and about 2 more at intervals above, up to about 24 cms. long; rachis thickened, terete, dense, gradually lengthening, dark green, up to about 6 cms. long. Bracts triangular, acuminate, acute, dry when mature, 5-nerved, appressed to pedicel, outside keeled convex, inside concave, up to c. 1.10 cms. long, c. 1 cm. wide. Flowers appearing singly at intervals of a few weeks and lasting for several days, inodorous, widely expanded, about 4.30 cms. long. Upper sepal erect, incurved below middle, lanceolate, acute, 5-nerved, margins above base triangularly dilate, inside concave, outside convex keeled furfuraceous ochreous densely spotted red, c. 2.35 cms. long, c. .60 cm. wide. Lateral sepals running down almost to apex of column foot, spreading, falcately ovate-lanceolate, acute, 5-nerved, posterior half above base twisted and strongly incurved, inside acutangularly concave, outside acutangularly convex furfurraceous with a tall laterally compressed median keel produced beyond the apex, ochreous densely spotted and suffused red, c. 2.50 cms. long, c. .70 cm. wide. Petals very small, strongly recurved from base, appressed to ovary, triangular-oblong, apex produced to a minute point, anterior margin strongly dilate at base, 3-nerved, margins minutely erosulous, outside at base minutely papillose, ochreous spotted red, c. .20 cm. long and at base about as wide. Lip adnate by a short broad triangular lamella to apex of column foot, base erect apex recurved, entire, mobile, ligulate, fleshy, apex acute, below the middle slightly decurved, above in basal 1/3 deeply concave with a median groove, a verrucous keel runing from the margins to the apex of the median groove, in upper 2/3 convex verrucous and minutely papillose, margins at base erect, above the base produced to a minute dentate auricle (side lobe ?), above the auricle abruptly decurved, beneath subverrucous narrowly concave on each side of a wide median grooved keel with the groove produced nearly to the apex of the lip, ochreous spotted red and suffused red towards the base, c. 1.60 cms. long, c. .60 cm. wide. Column slightly curved, flattened on back, a

little laterally dilate towards apex, dark wine colour, c. .58 cm. long, arms very short broad truncate; clinandrium semilunate, deeply excavate with a median keel, margins truncate, dark wine colour; rostellum broad, whitish; stigma scarcely excavate, broadly ovate, c. .30 cm. wide. Anther cucullate, biloculate loculi separate diverging towards apex, seen from above transversely oblong, base rounded with a short median groove above, ochreous spotted dark wine colour, c. .18 cm. long, c. .22 cm. wide. Pollinia 4, unequal, cohering in 2 obpyriform bodies, yellow, c. .10 cm. long. Column foot forming at base an obtuse angle with column, broad, linear, narrowed towards apex, apex produced to a triangular diverging lobes, dark wine colour, c. .70 cm. long c. .28 cm. wide. Ovary 6-sulcate, furfuraceous, green suffused dark wine colour, c. .52 cm. long, pedicel furfuraceo-punctate, in colour similar, c. 1.10 cms. long.

Below Wray's Camp by a tributary of the Reriang on trunks of trees, altitude about 3,300 feet.

**Bulbophyllum** (*Section Dialeipanthe*) **cleistogamum,** *Ridl. in Journ. Linn. Soc. XXXI. 297; Fl. Mal. Pen. IV. 69.* Rhizome creeping, branched, covered with dry tubular sheaths, fully .33 cm. diam., internodes .20–.40 cm. long. Pseudobulbs 1–2 cms. distant, cylindric-conic, curved, at first smooth and covered with membraneous sheaths soon breaking up into fibres, later longitudinally wrinkled, green, 1.50–3 cms. long, up to 1 cm. diam. at the base, 1–leaved. Leaf linear to linear-oblanceolate, apex acute, above base recurved, above dark green, the median nerve sulcate, below opaque paler, the median nerve conspicuously elevate, 19-13 .50 cms. long, 2–4.50 cms. wide, petiole grooved 1–2 cms. long. Inflorescence from base of pseudobulb, erect, many flowered; peduncle terete, thickened upwards, with about 2 tubular sheaths at base and about 4 tubular sheaths scattered above, green suffused black-purple, up to 30 cms. or more long; rachis thickened, zigzag, gradually lengthening, up to about 5 cms. long, internodes rounded on back flattened or slightly concave inside .30–.40 cm. long. Bracts alternate, triangular, acute, on back strongly keeled with the keel produced beyond the apex, inside acutangularly concave with the sides infolded and almost contiguous, base for c. .15 cm. embracing the rachis, green, base and keel darker, c. .90 cm. long, spread out c. .70 cm. wide. Flowers appearing singly at intervals of many weeks, widely expanded or more rarely closed and cleistogamous. Sepals spreading yellowish green tinted red, veins and margins red with red reticulation. Upper sepal erect, oblong-lanceolate, apex acutely apiculate often incurved, 7–nerved, inside deeply concave, outside highly convex furfuraceous, nerves elevate median nerve strongly elevate, c. 2.50 cms. long, c. .80 cm. wide. Lateral sepals falcately triangular, acute,

nerves 7 reticulate with 2 short extra nerves outside in basal half, inside deeply concave, outside highly convex furfuraceo-punctate, keels elevate median fully 1 cm. wide. Petals very small, subfalcately ovate 1-nerved with a very short nerve on each side, margins in upper half laciniate and serrate, apex produced to a long cusp with a shorter subulate diverging irregularly margined lobe on each side, transparently pale yellow-green with 3 dark red striae not reaching the base, without cusp c. .33 cm. long, .35 cm. wide cusp c. .30 cm. long, apical lobes c. .07 cm. long. Lip adnate by a short broad lamella to apex of column foot, mobile, entire, tongue-shaped, fleshy, margins at base erect produced above to a short denticulate auricle, above at base concave shiny with a short median grooved keel and a much shorter thicker keel on each side, above the median keel convex and tumid–rugulose grooved, the groove reaching almost to the apex, 2 short keels running from the auricles transversely to the median groove and there evanescent, below in basal 1/3 convex, above rather flattened and tumid-rugulose, dark red, 1.50–2 cms. long, c. .70 cm. wide. Column continuing the ovary, nearly straight, stout, yellow, on back c. .50 cm. long; arms subhorizontally spreading subquadrate, apex produced to 2 yellow lobules, upper one short triangular, lower one much longer subulate sigmoidly curved, c. .10 cm. long; clinandrium excavate, narrowly transversely elliptic; rostellum minute, incomplete, transversely oblong; stigma large, slightly excavate, produced below to 2 oblong divergent lobes. Anther cucullate, grooved, seen from above suborbicular, pale yellow with a large median dull red spot, c. .15 cm. long. Column foot forming at base a right angle with column, towards apex recurved, apex itself slightly dilate, dark red, c. .67 cm. long. Ovary 6-sulcate, furfuraceous, green, c. .70 cm. long, pedicel terete about as long.

The name is perhaps a little unfortunate since the great majority of the flowers seen by me expand widely. The flower is nearly always self-fertilized though this is not invariably the case. The rostellum is reduced to the central area of paste-like substance which is present in all species of this genus and the genus *Dendrobium*, the remaining part being entirely suppressed. When therefore the stigmatic fluid attains its maximum development, the pollinia gain contact with it towards the sides of the stigma and fertilization ensues.

Tahan river on tree overhanging the water, altitude about 350 feet.

**Bulbophyllum** (*Section Aphanobulbum*) **vaginulosum,** *sp. nov.* Rhizoma repens. Pseudobulbi remoti, depressi, disciformi. Folium oblongo-lanceolatum, acuminatum, obtusum aut minute bidentatum. Inflorescentiae erectae

laxe multiflorae, pedunculo terete basi vaginulis c. 6 arcte tubulosis tectis. Bracteae quaquaversae, lineari-lanceolatae, acuminatae, acutae. Sepalum dorsale lineare vel e basi longe unguiculata elliptico-lanceolatum, acuminatum, acutum. Sepala lateralia subfalcate oblonga, brevissime caudata. Petala rhombeo-elliptica vel e basi unguiculata lanceolata, acuta obtusave, intus in 2/3 partibus superioribus dense papillosa et ciliolata. Labellum mobile, inconspicue 3-lobum; lobi laterales rotundati, marginibus basi excepta minute papillosis; lobus intermedius triangulari-oblongus, obtusus, dense minute papillosus. Gynostemium breve, alis apici in dentem brevem subulatum productis. Pes gynostemii elongatus, sub apice in gibba magnum latum humile elevatus.

Rhizome creeping, c. .40 cm. diam. covered with dry sheaths, internodes more or less 1 cm. long. Pseudobulbs remote, very small, depressed, disciform, longitudinally wrinkled, covered with dry sheaths, c. .18 cm. long, c. .30 cm. diam., 1-folii. Leaf erect, oblong-lanceolate, acuminate obtuse or minutely bidentate, rather thickly fleshy, margins very shortly recurved, base abruptly narrowed to the petiole, green, c. 13 cm. long, c. 2.66 cm. wide, petiole oval in transverse section, grooved, c. 5 cm. long, .18–.20 cm. diam. Inflorescences from base of pseudobulb, erect, laxly many-flowered; peduncle terete, green, c. 6 loosely tubular green sheaths at base, often a lanceolate acute one above, 3–8 cm. long; rachis pale green up to c. 14 cm. long. Bracts much exceeding pedicel and ovary, linear-lanceolate, acuminate, acute, furfuraceo-punctate, whitish, c. .60 cm. long, c. .14 cm. wide. Sepals and petals semitransparently pale yellow, apex darker. Upper sepal linear or elliptic-lanceolate from a long-clawed base shortly acuminate, acute, base slightly dilate and thickened, 3-nerved, inside concave, outside convex, c. .55 cm. long, c. .18 cm. wide, claw c. .25 cm. long. Lateral sepals running down almost to apex of column foot, subfalcately oblong, narrowed shortly caudate below apex, anterior margin dilate at base to a short broad conic obtuse roundly dilate mentum, 3-nerved, inside concave, outside convex keeled, c. .55 cm. long, c. .30 cm. wide. Petals porrect above back of column, rhombeo-elliptic or lanceolate from a clawed base, acute or obtuse, 1-nerved, inside densely papillose in 2/3 upper part margins ciliolate, c. .28 cm. long, c. .10 cm. wide, claw c. .08 cm. long. Lip adnate to apex of column foot, mobile, inconspicuously 3-lobed, sides erect margins recurved, inside grooved in lower half, a wide grooved keel reaching the apex beneath, yellow base paler, spread out c. .35 cm. long, across side lobes c. .20 cm. wide; side lobes rounded, margins papillose except at base; mid-lobe recurved, triangular-oblong, obtuse, fleshy, convex above, keeled below, densely minutely papil-

lose. Column short, straight, wings broad produced at apex to a short subulate tooth, clinandrium small transversely oblong, rostellum short broad truncate, stigma deeply excavate narrowly oblong. Anther cucullate, yellow. Pollinia 4, yellow. Column foot elongate, making a right angle with column, apex incurved, a large broad low gibba below apex. Ovary and pedicel sigmoidly curved, clubbed, pale yellow, with pedicel c. .50 cm. long.

This belongs to the group possessing a distinct gibba on the column foot.

The main ridge at an altitude of about 6,000 feet.

Described from living plants.

**Bulbophyllum tahanense,** *sp. nov.* Rhizoma repens. Pseudobulbi conici vel elongato-conici, dimidio inferiore ad rhizoma adpressi. Folium oblongo-ellipticum ad lineari-oblongum, apici recurvum breviter angusteque retusum. Inflorescentiae laxe multiflorae, pedunculo gracili rigido, rachide multo longiore. Bracteae minimae, ovatae, acuminatae, obtusae. Flores subsecundi. Sepalum dorsale oblongo-lanceolatum, acuminatum, anguste obtusum. Sepala lateralia falcate oblonga, acuminata, subacuta. Petala subfalcata, late lanceolata, anguste obtusa. Labellum integrum, panduriforme, breviter acuminatum, anguste obtusum. Gynostemium breve, alis in dentem brevem erectum productis. Anthera cucullata, in rostrum breve triangulare subacutum producta.

Rhizome creeping, covered with dry sheaths, c. .35 cm. diam., internodes .40–.60 cm. long. Pseudobulbs 1–3 cm. distant, conic or elongate-conic, basal half prostrate and appressed to rhizome, in middle recurved, longitudinally wrinkled, yellow-green, 1.25–2 cm. long. 1-leaved. Leaf erect, oblong-elliptic to linear-oblong, apex recurved shortly narrowly retuse, base narrowed to the twisted grooved petiole, rather thickly fleshy, grooved above, keeled below, greenish yellow, 2.50–8.50 cm. long, .90–1.75 cm. wide petiole .20–1 cm. long. Inflorescence from base of pseudobulb, erect or erecto-patent, laxly many-flowered above, pale yellow; peduncle terete, slender, rigid, some tubular sheaths at base, 2–4.50 cm. long; rachis terete, a tubular sheath at base and some empty bracts above, 7.50–15 cm. long, upper part for 5–7 cm. laxly 7–20 flowered. Bracts very small, ovate, acuminate, obtuse, inside concave, outside convex, c. .12 cm. long, c. .09 cm. wide. Flowers fairly expanded, subsecund, lasting for several days, scentless. Upper sepal porrect, oblong-lanceolate, acuminate narrowly obtuse, 3-nerved, cucullately incurved above middle, inside concave, outside convex keeled, keel pale orange, yellow, scarcely 1 cm. long, c. .28 cm. wide. Lateral sepals running down to below middle of column foot, base slightly diverging, recurv-

ed in middle, falcately oblong, acuminate, subacute, anterior margin slightly dilate in lower 1/3, 3-nerved, yellow, inside concave especially towards apex, outside convex with a pale orange keel, some minute purple dots at base of posterior margin, c. 1 cm. long, c. .30 cm. wide. Petals subparallel, apex recurved, subfalcate, broadly lanceolate, narrowly obtuse, thin, 1-nerved, pale yellow a pale orange keel outside, fully .50 cm. long, c. .28 cm. wide. Lip adnate to apex of columns foot, mobile, entire, panduriform, shortly acuminate, narrowly obtuse, 5-nerved, margins at base erect produced to a rounded lobe recurved except at the acuminate part, sides deeply concave at base, above grooved with a conspicuously elevate keel on each side running from base to the acuminate part, convex towards apex, dark red, spread out c. .35 cm. long, c. .20 cm. wide. Column short, stout, pale yellow margins red, wings minutely red-dotted produced to a short erect tooth, the whole c. .10 cm. long, clinandrium excavate, triangular-ovate, stigma deeply excavate oblong produced below to a long linear lobe. Anther cucullate, produced to a short triangular subacute beak, c. .04 cm. long. Column foot incurved, narrowed to apex, above convex pale yellow red-spotted, c. 4 red striae beneath, c. .20 cm. long. Ovary 6-sulcate, furfuraceous, c. .30 cm. long, pedicel c. .70 cm. long.

On the ridge at the foot of Gunong Gedong, altitude c. 5,000 feet, No. 20,649. Flowered during August and September, 1928.

This plant has no near relative in this country. It appears best placed in Schlechter's section **Ischnopus** and is the first species of that section to be reported from the Peninsula.

**Bulbophyllum** *(Section Cirrhopetalum)* **lepidum,** *J.J.S. in Fl. Buit. VI. (Orch. 1905) 471; Atlas (1908) fig. CCCLXI.* On a tree overhanging the Teku River at Kuala Teku, altitude about 500 feet. This plant is new to the Peninsula.

Distribution:—Java, Borneo.

**Bulbophyllum** *(Section Cirrhopetalum)* **corolliferum, J.J.S. var. atropurpureum,** *J.J.S. in Bull. Jard. Bot. Buit. Ser. 2 XXV. (1917) 82; Bulbophyllum pulchellum, Ridl. var. purpureum, Ridl. Fl. Mal. Pen. IV. 80.* On a tree overhanging the Tahan river at Kuala Teku, altitude about 500 feet.

Distribution:—Sumatra, Borneo.

* **Dendrochilum angustifolium,** *Ridl. in Journ. Roy. As. Soc. S. Br. 39. 77; Mat. I. 85; Fl. Mal. Pen. IV. 82.* This plant occurred freely on the drier ridges such as Skeat's Ridge. It is worthy of notice that as far as could be judged

somewhere in the neighbourhood of 75% of the plants seen were growing in conjunction with the fern *Lecanopteris carnosa*, Bl., the old rhizome of the fern forming a shelter for the roots. On these dry ridges a large proportion of the plants were practically completely exposed to the sun, which had caused the pseudobulbs to take on a rich orange colour, but the rhizome of the fern formed a close mat over the substratum and retained sufficient moisture to enable the plants to thrive. Every fern examined was tenanted by ants.

This endemic species occurs commonly on the mountains of the Peninsula. No. 20655, altitude about 5,000 feet.

**Eria** *(Section Eriura)* **Ridleyi,** *Rolfe in Journ. Linn. Soc. XLII 150; Ridl. Fl. Mal. Pen. IV. 87; E. major, Ridl. Mat. I. 90 (not of Trans. Linn. Soc. IV. 237): E. Kingii, Hook. f. F. B. I. VI. 790; Ic. Pl. 2066: E. tahanensis, Ridl. in Journ. F. M. S. Mus. VI. 177; Fl. Mal. Pen. IV. 87.* Padang woods, and W. of the Upper Teku valley, at about 4,500 feet altitude, in flower No. 20741.

There is no authentic specimen of *E. tahanensis*, Ridl. in Singapore. If No. 16162 from Gunong Tahan and labelled in Ridley's writing as *Eria n. sp.* is intended for the type plant I can find no possible difference between it and *E. Ridleyi*, Rolfe. Endemic.

**Eria** *(Section Hymeneria)* **punctata,** *J. J. S. in Bull. Dep. Agr. Ind. Neerl. XIII. (1907) 38; Bull. Jard. Bot. Buit. Ser. 3 VI. t. 3. f. 14.* On a tree trunk on Observation Hill, at about 5,000 feet altitude. It occurs, less rarely, on the main range at Fraser Hill, but, as Dr. Smith points out, it is not often met with in flower.

Distribution:—Java.

**Eria** *(Section Hymeneria)* **suaveolens,** *Ridl. in Journ. Linn. Soc. XXXII. 292., etc.* on trees by the Tahan and Teku rivers at an altitude of about 500 feet. Endemic.

**Porpax meirax,** *King and Pantling in Ann. Bot. Gard. Calc. VIII. 115; Ridl. Mat. I 105; Fl. Mal. Pen. IV. 104; Eria meirax, N. E. Br. in Gard. Chron. 1880. 603; Hook. f. in Fl. Brit. Ind. VI. 786.* This plant has been found once previously in the Peninsula, on Kedah Peak. It was found on Gunong Tahan low down on mossy tree trunks in damp jungle by the side of a tributary of the Reriang below Wray's Camp at about 3,300 feet altitude.

Distribution:—Tenasserim and the Himalayas.

**Agrostophyllum longifolium,** *Rchb. f. in Bonpl. V. 41; J. J. S. in Fl. Buit. VI. (Orch. 1905) 290; Agrostophyllum majus, Hook. f. in Fl. Brit. Ind. V. 824; Ic. Pl. 2096; Ridl. Mat. I. 108; Fl. Mal. Pen. IV. 107; Appendicula longifolia,*

*Bl. Bijdr. 304; Lindl. Gen. & Sp. Orch. 240; Miq. Fl. Ind. Bat. III. 704.* A common plant throughout the Peninsula at all altitudes, it was found on trees in the neighbourhood of Kuala Teku at an altitude of about 500 feet.

Distribution:—Java, Sumatra, Ambon.

**Agrostophyllum glumaceum,** *Hook. f. in Fl. Brit Ind. V. 821; Ic. Pl. 2095; Ridl. Mat. 108; Fl. Mal. Pen. IV. 107;* This plant was found on the branches and trunks of small trees by the side of the Teku river at Kuala Teku, at an altitude of about 500 feet (No. 20558). Endemic.

**Ceratostylis** (*Section Pleuranthemum*) **eriaeoides,** *Hook. f. Ic. Pl. 2,074; Ridl. Mat. I. 110; Fl. Mal. Pen. IV. 110; Eria pygmaea, Hook. f. in Fl. Brit. Ind. V. 804.* A rare endemic species occuring on the hills of the Peninsula. On Gunong Tahan it was found on Skeat's Ridge at about 4,500 feet altitude (No. 20648) and also on the main ridge at about 6,000 feet altitude.

It is noteworthy that, as far as all events as we are concerned, a large number of the species of this genus are xerophytic, thriving on the more or less dry and exposed ridges of the mountains of the Peninsula. They are most difficult of cultivation in the plains.

**Calanthe** (*Section Styloglossum*) **rigida,** *sp. nov.* Caulis cylindrico-conicus. Folia c. 5, lanceolata, acuminata, acutissima, costis 6–7 prominentibus, petiolo longiusculo. Inflorescentiae dense multiflorae. Bracteae lanceolatae, acuminatae, acutissimae. Sepala brevissime acuminata, acutissima, sepalo dorsali oblongo-oblanceolato, sepalis lateralibus lanceolatis. Petala subfalcate lineari-obovata, breviter acuminata, acuta. Labellum marginibus basi gynostemio in forma tubae adnatum, 3-lobum, calcaratum, basi carinis 2 brevibus ornatum; lobi laterales falcate triangulares, subacuti; lobus intermedius apici bilobus lobis late rotundatis marginibus erosulis, in sinu loborum in dentem triangularem acutum productus; calcar pendulum, cylindricum, lateribus sub apicem anguste obtusum dilatatis, carinis 3 conspicue elevatis. Gynostemium dorso rotundatum, lateribus perplanum, alis truncatis, rostello in rostrum subulatum acutissimum producto.

Stems approximate or subapproximate, erect, thick, cylindric-conic, internodes narrowed towards apex, green, up to c. 5 cm. long, base c. 2.50 cm. diam., internodes .20–.70 cm. long, apical internode very small. Leaves erecto-patent, lanceolate, acuminate below the very acute apex, green, below paler with 6 7 yellow-green prominent nerves, base narrowed to petiole, 50–60 cm. long, or longer up to c. 7 cm. wide, petiole grooved 20 cm. long or longer. Inflorescence

from nodes of stem, erect, stout, glabrous densely many-flowered, peduncle terete with some tubular sheaths, pale green c. 25 cm. long, rachis pale green c. 12 cm. long. Bracts caducous, lower ones largest, lanceolate, acuminate, very acute, pale green. Sepals and petals fairly expanded, bright golden. Upper sepal oblong-oblanceolate, very shortly acuminate below the very acute apex, 3-nerved nerves branched and reticulate, cucullately incurved above middle, margins recurved towards apex, inside concave, outside convex, c. 1.33 cm. long, c. .60 cm. wide. Lateral sepals lanceolate, very shortly acuminate below the produced very acute apex, 3-nerved, nerves branched and reticulate, incurved towards apex, margins incurved towards apex, inside concave, outside convex, c. 1.33 cm. long, c. .55 cm. wide, Petals subfalcately linear-obovate, shortly acuminate below the acute apex, 3-nerved, nerves branched and reticulate, midnerve grooved outside almost to apex, almost 1.20 cm. long, c. .60 cm. wide. Lip 3-lobed, spurred, margins at base for about .33 cm. adnate to column in form of a tube, 5-nerved, nerves branched, a short orange keel at base on each side of the midnerve, golden, blade orange, spread out 1.15–1.50 cm. long, across side lobes c. .75 cm. wide; side lobes erect, falcately triangular, subacute, 3-nerved, nerves branched, posterior margin roundly erosulous c. .40 cm. long, anterior margin c. .15 cm. long; midlobe cuneately dilate at base, slightly narrowed towards apex, apex bilobed, lobes broadly rounded, margins erosulous, a triangular acute tooth in sinus, 7-nerved, nerves branched, .50–.60 cm. long; spur pendulous, making an acute angle with ovary, slightly incurved beyond middle, cylindric, sides dilate below the narrowed obtuse apex, keels outside 3 conspicuously elevate, scarcely 1 cm. long, c. .40 cm. wide. Column entirely adnate to margins of lip blade, continuing the ovary, dilate towards apex, rounded on back, sides rather flat, concave inside, wings broad truncate broadly subcarinate, yellow, c. .60 cm. long, at apex c. .38 cm. wide, clinandrium conic-excavate suborbicular c. .20 cm. wide, rostellum triangular with a short median keel apex produced to a subulate very acute c. .18 cm. long beak. Anther cucullate, seen from above ovate, acute, white. Pollinia 8, narrowly linear-obpyriform, joined to a subulate gland. Ovary 6-sulcate, green, scarcely 1.10 cm. long, pedicel terete green about as long.

Padang woods by streams on damp rotting humus (No. 20684) at an altitude of about 5,500 feet.

I mistook this at first for a small state of *C. speciosa*, Lndl. as the spur is somewhat similar. It differs, however, from this in the structure of the lobes of the lip, in this respect much more resembling the succeeding species.

Described from spirit material and field notes.

**Calanthe** *(Section Styloglossum)* **angustifolia,** *Lindl. Gen. & Sp. Orch. Pl. 251; Fol. Orch. 5; Miq. Fl. Ind. Bat. III. 710; Rchb. f. Walp. Ann. VI. 914; Ridl. Mat. I. 121; Fl. Mal. Pen. IV. 120; J. J. S. in Fl. Buit. VI (Orch.) 205; Atlas f. CLII; C. phajoides, Rchb. f. Bonpl. V. 37; Xen. Orch. I. 207. t. 79. II; Hook. f. Ic. Pl. IX. t. 1864; Amblyglottis angustifolia, Bl. Bijdr. 369; Alismorchis angustifolia, O. K. Rev. Gen. Pl. II 650; A. phajoides, O. K. l. c.* A fairly well distributed plant throughout the hills in the central and northern parts of the Peninsula. On Gunong Tahan it occurred in the Padang woods at 5,500 feet altitude (No. 20683, the *var. flava* of Ridley), while both forms occurred on the main ridge at about 6,000 feet altitude.

Distribution:—Sumatra and Java.

**Calanthe** *(Section Styloglossum)* **aurantiaca,** *Ridl. in Journ. Roy. As. Soe. Str. Br. XXXIX. 80; Mat. I. 122; Fl. Mal. Pen. IV. 120.* An endemic species occurring on the hills of the Peninsula. On Gunong Tahan it was found (No. 20583), together with the succeeding species, in damp woods below Wray's Camp at about 3,300 feet altitude.

**Calanthe** (*Section Styloglossum*) **pusilla,** *sp. nov.* Rhizoma repens. Caules ad c. 3.50 cm. dissiti, brevissimi, c. 5-folii. Folia lineari-lanceolata vel lineari-oblanceolata, acuminata, acuta, plicata, petiolo sulcato. Inflorescentiae erectae, laxe 2–20-florae. Bracteae quaquaversae, mox caducae, lanceolatae, acuminatae, acutissimae. Sepalum dorsale oblongo-obovatum, breviter acuminatum, acutum. Sepala lateralia oblongo-elliptica, brevissime acuminata, acuta. Petala basi lineariter unguiculata, superne ovato-oblonga, brevissime acuminata, acuta. Labellum 3-lobum, calcaratum, marginibus laminae gynostemio adnatis, carinis 2 brevibus inter lobos laterales; lobi laterales quadrati, margine apicali vix rotundati; lobus intermedius lineari-oblongus, brevissime acuminatus, obtusus; calcar pendulum, teres, satis lateraliter compressum, apicem versus leviter incurvum. Gynostemium intus valde concavum, clinandrio transverse quadratum conico-excavato in carinam mediam elevato, rostello subulatim rostrato. Anthera cucullata, triangulari-ovata, acuta. Pollinia 8, anguste lineari-obpyriformia, glandula anguste subulata.

A dwarf plant. Rhizome creeping, up to .45 cm. diam., internodes up to c. .80 cm. long. Stems up to c. 3.50 cm. distant, erect, very short, cylindric, narrowed to apex, green, .75-1.25 cm. long, internodes c. 5 up to c. .25 cm. long. Leaves c. 5, lower 2 reduced to sheaths, linear-lanceolate or linear-oblanceolate, acuminate, acute, plicate, thinly flaccid, margins undulate, above concave grooved opaque grey-green, below convex conspicuously keeled paler, up to c. 18 cm. or more long, 3-6 cm. wide, petiole grooved green up to c. 4 cm.

long. Inflorescences erect, laxly 2-20-flowered; peduncle terete, rather slender, about 2 tubular sheaths at base and c. 5 loosely tubular sheaths above, pale green, up to c. 2.5 cm. long; rachis ribbed, up to c. 9 cm. long. Bracts soon caducous, lower ones largest, lanceolate, acuminate, very acute, base 5-above 3-nerved, inside concave sparsely pubescent, outside convex, pale green. Tepals fairly expanded, snow white. Upper sepal oblong-obovate, shortly acuminate. acute, nerves 5 outer ones short all branched and reticulate, incurved towards apex, inside concave, outside convex, c. 1.10 cm. long, c. .45 cm. wide. Lateral sepals oblong-elliptic, very shortly acuminate, acute, nerves 5 branched and reticulate, inside concave, outside convex, c. 1.10 cm. long, c. .45 cm. wide. Petals clawed at base, claw linear c. .25 cm. long c. .30 cm. wide, above claw ovate-oblong, very shortly acuminate, acute, nerves 3 branched and reticulate, the whole c. 1.10 cm. long, c. .55 cm. wide. Lip 3-lobed, spurred, margins of yellow blade adnate to column, 2 short yellow keels between side lobes, spread out from ovary to apex of midlobe c. 1.15 cm. long, across side lobes c. .60 cm. wide; side lobes quadrate, apical margin scarcely rounded, white, base yellow, c. .15-.20 cm. long, .20-.30 cm. wide; midlobe linear-oblong, very shortly acuminate, obtuse, snow white, scarcely .30 cm. long, c. .33 cm. wide; spur pendulous, making a right angle with ovary, terete, rather laterally flattened, slightly incurved towards the subclavate apex, c. 1.40 cm. long. Column adnate to margins of lip blade, continuing ovary, dilate towards apex, inside very concave, c. .50 cm. long, c. .25 cm. wide, c. .30 cm. thick; clinandrium large, transversely quadrate, conic-excavate with a median keel; rostellum triangular, produced to a long narrowly subulate beak, beak c. .18 cm. long; stigma small, semilunate. Anther cucullate, white, seen from above triangular-ovate, acute, a median keel near base, c. .28 cm. long, c. .15 cm. wide. Pollinia 8, narrowly linear-obpyriform, c. .15 cm. long, gland, narrowly subulate c. .15 cm. long. Ovary 6-sulcate, c. .85 cm. long, pedicel terete c. 1.10 cm. long.

An ally of **C. rajana**, J.J.S. from West Borneo, this plant occurred not uncommonly in moist forest along the valley of a tributary of the Reriang below Wray's Camp at an altitude of about 3,300 feet (No. 20590) together with the preceding species.

Described from living plants, inflorescences preserved in alcohol and colour notes taken in the field.

**Cymbidium** *(Section Eucymbidium)* **Dayanum,** *Rchb. f. in Gard. Chron. 1869. 710; Ridl. Fl. Mal. Pen. IV. 146; C. acutum, Ridl. in Journ. Linn. Soc. XXXII. 334; Mat. I. 140; C. Simonsonianum, King & Pantling, in Ann. Bot. Gard. Calc. VIII. 188. Pl. 250.* Kuala Teku on trees overhanging the river, at an altitude of about 500 feet.

Distribution:—Sikkim and Assam.

**Cymbidium** *(Section Cyperorchis)* **roseum,** *J. J. S. in Fl. Buit. VI. (Orch. 1905) 475; Bull. Jard. Bot. Buit. Ser. 3. VI. (1924). t. 11. f. 1; Cyperorchis rosea, Schltr. in Fedde Rep. XX. (1924) 107; J. J. S. in Bull. Jard. Bot. Buit. Ser. 3. IX (1927) 57.* On the main ridge from Gunong Gedong (Skeat's Barrier Mountain) to the summit at 7,100 feet growing in peaty humus in open spots or among very thin dwarfed scrub, in flower and fruit (No. 20681).

This is the plant found here in fruit in July 1911 by Ridley, (No. 16163), and reported by him in *Journ. F. M. S. Mus. VI (1915) 182* under No. 221.

Distribution:—Java.

I do not well see how Schlechter's genus *Cyperorchis* can be maintained. The chief characteristics of that genus appear to be the unity of the base of the margins of the lip with the column and the caudicle of the pollinia which in the case of *Cyperorchis* is said to be longer and narrower than is the case in *Cymbidium.* This can undoubtedly be said of such plants as *Cymbidium sigmoideum,* J. J. S. *Cymbidium roseum,* J. J. S., however, which Schlechter himself places under his genus *Cyperorchis,* appears to me to unite the latter genus with *Cymbidium,* for while the margins of the lip are shortly adnate at the base to the column, the pollinia appear to be quite characteristic of the latter genus. In regard to habit and the structure of the flowers of the present plant other than the lip it would be most difficult generically to separate it from *Cymbidium.*

**Thrixspermum** (*Section Orsidice*) **tahanense,** *sp. nov.* Caulis longiusculus, erectus aut ascendens, validus. Folia oblonga ad oblongo-lanceolata, apici biloba, supra convexa sulcata, subtus concava conspicue carinata, vaginis tubulosis carinatis. Inflorescentiae multi-(ad c. 35 ) florae, pedunculo longiusculo inconspicue carinate, rachide longiuscula valde lateraliter compressa. Bracteae alternatim bifariae, basi tubulosae, parte libera valde carinata a latere visa falcate triangulari. Flores majusculi. Tepala haud caudata, lactea. Sepalum dorsale oblongum, longe acuminatum, acutum. Sepala lateralia falcata, lineari-ovata, longe acuminata, acuta. Petala lineari-ovata, longe acuminata, acuta. Labellum 3-lobum, basi profunde lateque saccatum, inter lobes laterales in callum magnum oblongo-ovatum obtusum elevatum, lobi laterales erecti, triangulari-ovati, obtusi, extus apicem versus papillosi; lobus intermedius conico-cylindricus, conico-papillosus; saccus late oblongus, medio dilatatus, apici retusus, intus papillosus et pilosus in carinam mediam elevatus. Gynostemium breve, rectum, intus linea media sulcate-concavum, alis latis rotundatis, clinandrio suborbiculari medio convexo, rostello brevi

triangulari acuto. Anthera cucullata. Pollinia 4, in corpusculis 2 oblongis cohaerentia, stipite oblongo-elliptico, glandula oblonga. Pes gynostemii triangular-oblongus.

Stem rather long, erect or ascending, stout, slightly sinuous, strongly laterally flattened, elliptic in transverse section, base branched, up to c. 30 cm. long, including sheaths up to c. .80 cm. wide, c. .50 cm. thick, internodes up to c. 3 cm. long. Leaves spreading, recurved towards apex, oblong to oblong-lanceolate, apex broadly unequally obtusely bilobed, rather thickly fleshy, above rather shiny convex on each side of the median groove, below opaque concave on each side of the conspicuous median rib, green often spotted dull purple, up to c. 9 cm. long, 2,50-3.50 cm. wide, sheaths tubular keeled in front and on the slightly rounded back, rather shinily green often spotted dull purple. Inflorescences from base of sheaths behind leaves, porrect or suberect, many- (up to c. 35–) flowered; peduncle rigid, narrowly elliptic in transverse section, inconspicuously keeled in front and on back, dilate towards apex, yellow-green, up to c. 15 cm. long; rachis thickened, strongly laterally flattened, internodes excavate on side facing the flower, a bracteiform but much smaller sheath at base, up to c. 15 cm. long, with bracts c. 1.30 cm. wide. Bracts alternate, base tubular, above middle free, spreading, laterally flattened and conduplicate, strongly keeled on back, free part seen from side falcately triangular, yellow-green often spotted and suffused dull purple, margins c. 1 cm. back c. 1.20 cm. long, tubular part .50–.60 cm. long. Flowers opening 1 or 2 at a time, lasting 1 day, rather large, scentless, c. 6.70 cm. wide. Tepals not caudate, semitransparently cream coloured. Upper sepal oblong below, above narrowed and long-acuminate, acute, 5-nerved, inside concave outside convex fairly conspicuously keeled, 4–4.75 cm. long, c. .55 cm. wide. Lateral sepals adnate to column foot, falcate, sigmoidly curved above, linear-ovate, long-acuminate, acute, 5-nerved, inside concave, outside convex fairly conspicuously keeled, 4–5 cm. long, c. .60 cm. wide. Petals linear-ovate, long-acuminate, acute, sigmoidly curved above, 3-nerved, outer nerves short, inside slightly concave, outside slightly convex, 3.75–4.25 cm. long, c. .40 cm. wide. Lip adnate to apex of column foot, 3-lobed, base deeply and broadly saccate, obtusangularly recurved in middle, a large oblong-ovate obtuse fleshy white palely and dully fusco-suffused callus between side lobes, spread out c. 1.85 cm. long, across side lobes c. 1.50 cm. wide; side lobes erect, rather fleshy, triangular-ovate, obtuse, posterior margin roundly curved and incurved over column, white, shiny inside, outside papillose towards apex; midlobe obtusangularly recurved, conic-cylindric, fleshy, conic-papillose, above triangularly depressed at base, beneath flat, whitish, c. 1 cm. long, base c. .60 cm wide; sac short, broadly oblong, dilate in middle, apex retuse, inside papillose and ochre-hairy with a median keel, yellow-

white, a large brown-purple spot at base. Column making an obtuse angle with ovary, short, straight, apex truncate, inside sulcato-concave on the median line, white, c. .17 cm. long, c. .22 cm. wide, wings broad rounded fleshy white; clinandrium scarcely excavate, suborbicular, convex in middle, white; restellum short, triangular, acute; stigma small, deeply excavate, transversely oval, basal margin produced in middle to a triangular obtuse lobule. Anther cucullate, biloculate, white, c. .17 cm. long, c. .20 cm. wide. Pollinia 4, cohering in 2 oblong bodies, pale yellow-white, anterior 2 c. .12 cm. posterior 2 c. .10 cm. long; stipe (caudicle) oblong-elliptic, incurved above middle, recurved below apex, convex above, concave below, white, c. .10 cm. long, c. .05 cm. wide; gland (disc) small, oblong, pale yellow. Column foot continuing column, triangular-oblong, dilate above the slightly narrowed base, apex narrowed, inside concave, c. .30 cm. long, c. .40 cm. wide. Ovary 6-sulcate, yellow-green, c. 1.60 cm. long.

On the stones of the drain of one of the huts on the Padang, about 3,400 feet altitude. Described from living plants.

**Thrixspermum** (*Section Dendrocolla*) **recurvum,** *comb. nov.* Thrixspermum brevicaule, Carr in Gard. Bull. S. S. V. (1929) 35. t. XV; Sarcochilus recurvus, Hook. f. Fl. Brit. Ind. VI. 39; Ic. Pl. I have little doubt that this species is referable to Hooker's plant since the inflorescence and bracts are most distinctive.

It was found at Kuala Teku on branches of trees overhanging the Teku river, about 500 feet altitude. In the Teku plants the sepals were distinctly apiculate and the brown markings were much paler than in the Tembeling and Krambit plants.

**Pennilabium struthio,** *sp. nov.* Caulis brevis, ascendens. Folia 4–5, falcata, lineari-lanceolata, apici inaequaliter biloba, vaginis tubulosis apicem versus recurvis. Inflorescentiae pauciflorae, pedunculo lateraliter compresso, rachide latiore valde lateraliter compressa facie antica dorsoque canaliculata. Bracteae alternatim bifariae, rachidem amplectantes, late et breviter triangulares, acutae, extus carinatae. Sepalum dorsale e basi brevissime unguiculata reflexum, ellipticum, breviter apiculatum, marginibus dimidio superiore minute erosulis, extus sparse verrucosum. Sepala lateralia e basi unguiculata oblique oblonga, breviter apiculata, marginibus dimidio superiore minute erosulis, extus sparse verrucosa. Petala breviter unguiculata, subfalcata, super basin elliptico-obovata, obtusa, marginibus in 1/3 parte superiore irregulariter dentatis. Labellum 3-lobum, calcaratum, super faucem calcaris in lamellas 2 erectas triangulares bidentatas parallelas

marginibus anticis lamella transversa simili conjunctas conspicue elevatum; lobi laterales falcati, lineari-cuneati, truncati, marginibus apicem versus laciniatis, laciniis in appendices multas cylindricas breviter pilosas productis; lobus intermedius valde lateraliter compressus, omnino papillosus, a latere visus linearis, super medium abrupte incurvus linearis sub apice subulato-acuminatus anguste obtusus; calcar majusculum, anguste cylindricum, sub apice obtuso dilatatum. Gynostemium breve, clinandrio suborbiculari, rostello in rostrum subulatum producto, stigmato maximo suborbiculari. Anthera cucullata, supra visa transverse subquadrata. Pollinia 2, subglobosa, stipite anguste lineari apicem versus triangulariter dilatato, glandula minuta anguste ovali. Ovarium breviter clavato-pilosum.

Stem short, ascending, 6–5-leaved, rooting below, 1–2 cm. long. Leaves spreading, falcate, linear-lanceolate, apex unequally bilobed, longer lobe obtuse, shorter one obtuse or acute and tooth-like, base narrowed and slightly twisted, rather fleshy, above convex on each side of the median groove rather shinily green, beneath opaque paler fairly conspicuously keeled, 4–6.50 cm. long, .90–1.30 cm. wide, sheaths tubular recurved towards apex dull green up to c. .50 cm. long. Inflorescences from base of sheaths behind leaves, porrect, few-flowered; peduncle terete, laterally flattened, bearing a few distant bracteiform sheaths, green, c. 1 cm. long; rachis broader, strongly laterally flattened, keeled in front and on back, green, c. 2.50 cm. long, c. .25 cm. wide. Bracts alternate, half embracing the rachis, broadly and shortly triangular, acute, inside acutangularly concave, outside highly convex keeled. Flowers opening 1–2 at a time and lasting 1 day, c. 1.70 cm. long, c. 1 cm. wide. Sepals strongly spreading,, semitransparently ochreous, inside spotted dark red except at base and apex. Upper sepal reflexed from the very shortly clawed base, incurved above middle, elliptic, shortly apiculate, apiculus conic acute, 5-nerved, margins in upper half minutely erosulous, inside concave, outside convex sparsely warty, c. 1 cm. long, c. .48 cm. wide. Lateral sepals adnate to base of column, recurved from the very shortly clawed base, above base obliquely oblong, apex shortly apiculate, apiculus conic acute, 5-nerved, margins in upper half minutely erosulous, inside concave, outside convex sparsely warty, c. 1 cm. long, c. .50 cm. wide. Petals spreading, incurved about middle, base shortly clawed, subfalcate, above base elliptic-obovate, obtuse, 3-nerved, margins in upper 1/3 irregularly toothed, inside concave, outside convex, ochreous spotted red, margins very thin paler, c. .85 cm. long, c. .50 cm. wide. Lip adnate to base of column, 3-lobed, spurred, lamellae 2 above mouth of spur, erect triangular 2-toothed parallel, transparently yellowish, margins dark red c. .18 cm. long c. .20 cm. wide, joined on

anterior margins by a similar transverse lamella; side lobes reflexed from base, anterior margins often contiguous in middle, large, falcate, linear-cunecate, truncate, margins laciniate towards apex, laciniae produced into very many cylindric shortly hairy .10-.15 cm. long appendages, rather shiny, semitransparently snow white, c. 1 cm. long, c. .35 cm. wide; midlobe above the broad base fleshy, strongly laterally flattened, entirely papillose, seen from the side porrect, linear in basal half, above middle abruptly and obtusangularly incurved, in upper half linear, subulate-acuminate below the narrowly obtuse apex, white, c. .35 cm. long, c. .15 cm. wide; spur rather large, porrect, nearly parallel to column, straight, narrowly cylindric, dilate below the narrowly obtuse apex, yellowish, fully 1 cm. long. Column short, dilate in middle, yellowish with a transverse pale red streak at base, c. .23 cm. long; clinandrium slightly excavate, suborbicular, produced on back; rostellum produced to a beak long subulate apex incurved c. .17 cm. long; stigma very large, suborbicular. Anther cucullate, seen from above transversely subquadrate, a short broad median keel at base, 2-celled, cells slightly elevate on back transversely oval separated by a median groove, opercula 2 suborbicular inside at base, apex produced to a beak large triangular shortly truncate convex above concave below. Pollinia 2, subglobose, yellow, joined to the caudicle by a rather stout highly elastic filament; caudicle very long, narrowly linear, triangularly dilate towards apex, below apex abruptly incurved elevate in a median keel bearing the filaments of the pollinia, margins above base revolute, white, c. .25 cm. long; disc minute, narrowly oval, yellowish. Ovary shortly club-bed-hairy.

Kuala Teku on a branch of a tree overhanging the Teku river at an altitude of about 500 feet.

A distinct species remarkable for the structure of the lip. The side lobes are particularly interesting with their curious fringe, quite unlike any plant of the group known to me. The specific name refers to the side lobes which show a passable resemblance to the tail feathers of an ostrich. The erect lamellae at the entrance to the spur are quite transparent and probably serve as guides to the maxillae of moths. The midlobe is curiously curved in the form of a hook.

Described from living plants in cultivation at Tembeling, Pahang.

## PLATE I.

**Fig. 1.** Oberonia subnavicularis, King & Pantling.

*a.* Bract.
*b.* Upper sepal.
*c.* Lateral sepal.
*d.* Petal.
*e.* Flower, from the side.
*f.* Flower, from the front.
*g.* Lip, spread out.
*h.* Column, from the side.
All enlarged.

**Fig. 2.** Oberonia lanpongensis, J.J.S.

*a.* Bract.
*b.* Upper sepal.
*c.* Lateral sepal.
*d.* Petal.
*e.* Anther, from above.
*f.* Flower, from the front.
*g.* Lip, spread out.
All enlarged.

**Fig. 3.** Dendrobium pahangense, Carr.

*a.* Bract.
*b.* Upper sepal.
*c.* Lateral sepal.
*d.* Petal.
*e.* Flower, from the front.
*f.* Flower, in section.
*g.* Lip, spread out.
*h.* Column, from the front.
*i.* Anther, from the front.
*j.* Pollinia.

**Fig. 4.** Dendrobium Hosei, Ridl.

*a.* Upper sepal.
*b.* Lateral sepal.
*c.* Petal.
*d.* Lip, spread out.
*e.* Anther, from the side.
*f.* Anther, from the front.
*g.* Pollinia.
*h.* Column, from the side.
*i.* Column, from the front.
*j.* Flower, from the side.
*a–i* enlarged, *j.* nat. size.

**Fig. 5.** Dendrobium Hosei, Ridl. var Pelor, Carr.

*a.* Flower, from the side.
*c.* Lateral sepal.
*c.* Petal.
*d.* Lip, spread out.
*e.* Column, from the front.
*b. c.* about nat. size, remainder enlarged.

# Plate I.

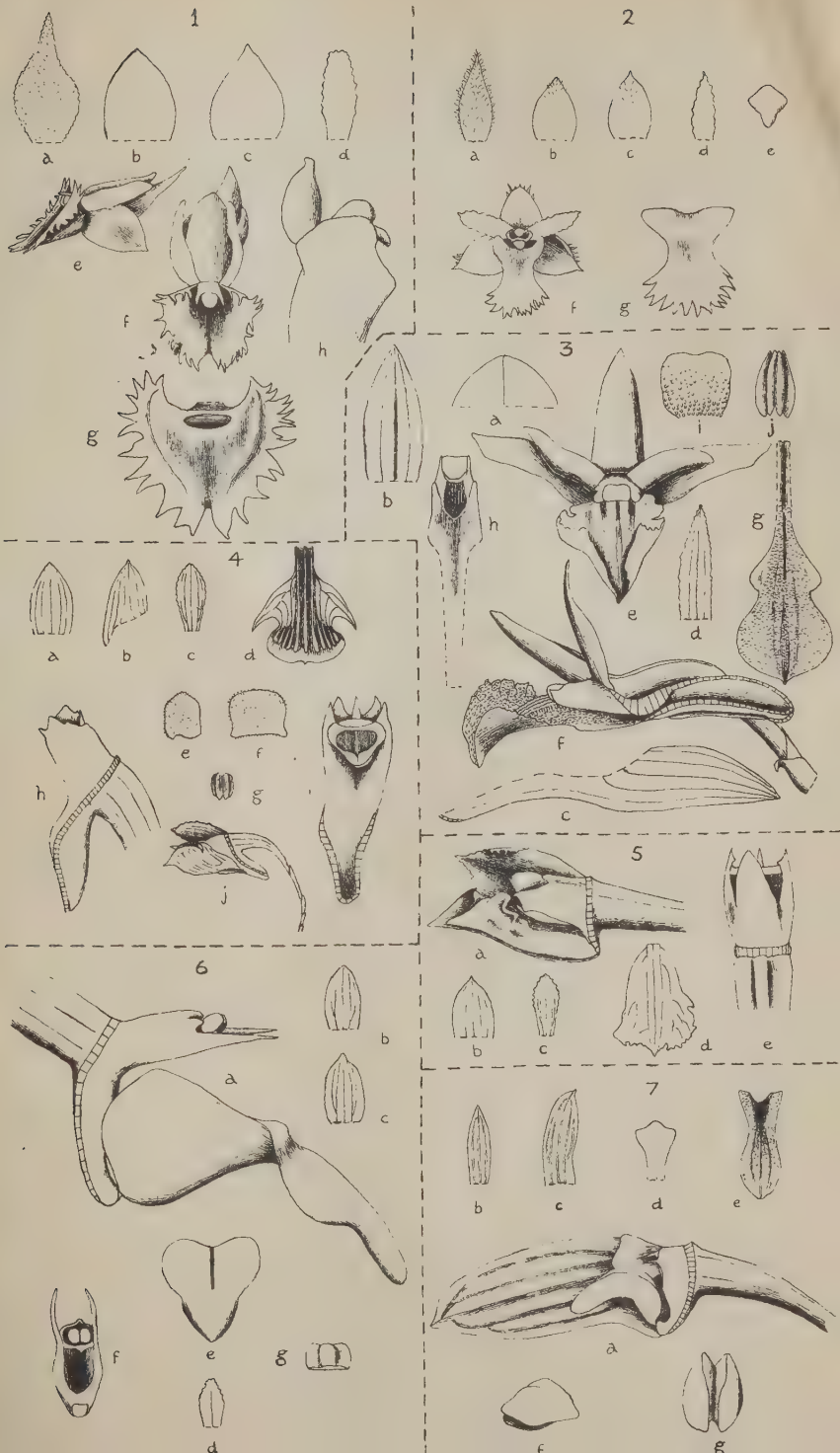
1
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**Fig. 6.** Bulbophyllum ignevenosum, Carr.
*a.* Lip and column, from the side.
*b.* Upper sepal.
*c.* Lateral sepal.
*d.* Petal.
*e.* Lip, spread out.
*f.* Column, from the front.
*g.* Anther, from above.
All enlarged.

**Fig. 7.** Bulbophyllum tekuense, Carr.
*a.* Flower, from the side.
*b.* Upper sepal.
*c.* Lateral sepal.
*d.* Petal.
*e.* Lip, spread out.
*f.* Anther, from the side.
*g.* Pollinia.
All enlarged.

## PLATE II.

**Fig. 1.** Bulbophyllum tristriatum, Carr.
*a*. Upper sepal.
*b*. Lateral sepal.
*c*. Petal.
*d*. Plant, nat, size.
*e*. Lip, spread out.
*f*. Anther, from above.
*g*. Column, from the side.
*a, b, d* nat. size, remainder enlarged.

**Fig. 2.** Bulbophyllum biseriale, Carr.
*a*. Upper sepal.
*b*. Lateral sepal.
*c*. Petal.
*d*. Plant, nat. size.
*e*. Plant, from above.
*f*. Lip, from above.
*g*. Lip, from below.
*h*. Lip and column, from the side.
*d, e* nat. size, remainder enlarged.

**Fig. 3.** Bulbophyllum dryas, Ridl.
*a*. Plant.
*b*. Portion of rhizome and inflorescence.
*c*. Pseudobulb.
*d*. Upper sepal.
*e*. Lateral sepal.
*f*. Petal.
*g*. Lip, spread out.
*h*. Flower in section, from the side.
*a* nat. size, remainder enlarged.

**Fig. 4.** Bulbophyllum Stella, Ridl.
*a*. Flower, from the side.
*b*. Bract.
*c*. Upper sepal.
*d*. Lateral sepal.
*e*. Petal.
*f*. Lip, from above.
*g*. Lip, from below.
*h*. Anther, from below.
*i*. Anther, from above.
*j*. 2 pollinia.
*a, b, c, d, f, g* nat. size; *e, h, i, j*, enlarged.

**Fig. 5.** Bulbophyllum cleistogamum, Ridl.
*a*. Flower, from the front.
*b*. Upper sepal.
*c*. Lateral sepal.
*d*. Petal.
*e*. Lip and column from the side.
*f*. Column, from the front.
*d* enlarged, remainder nat. size.

**Plate II.**

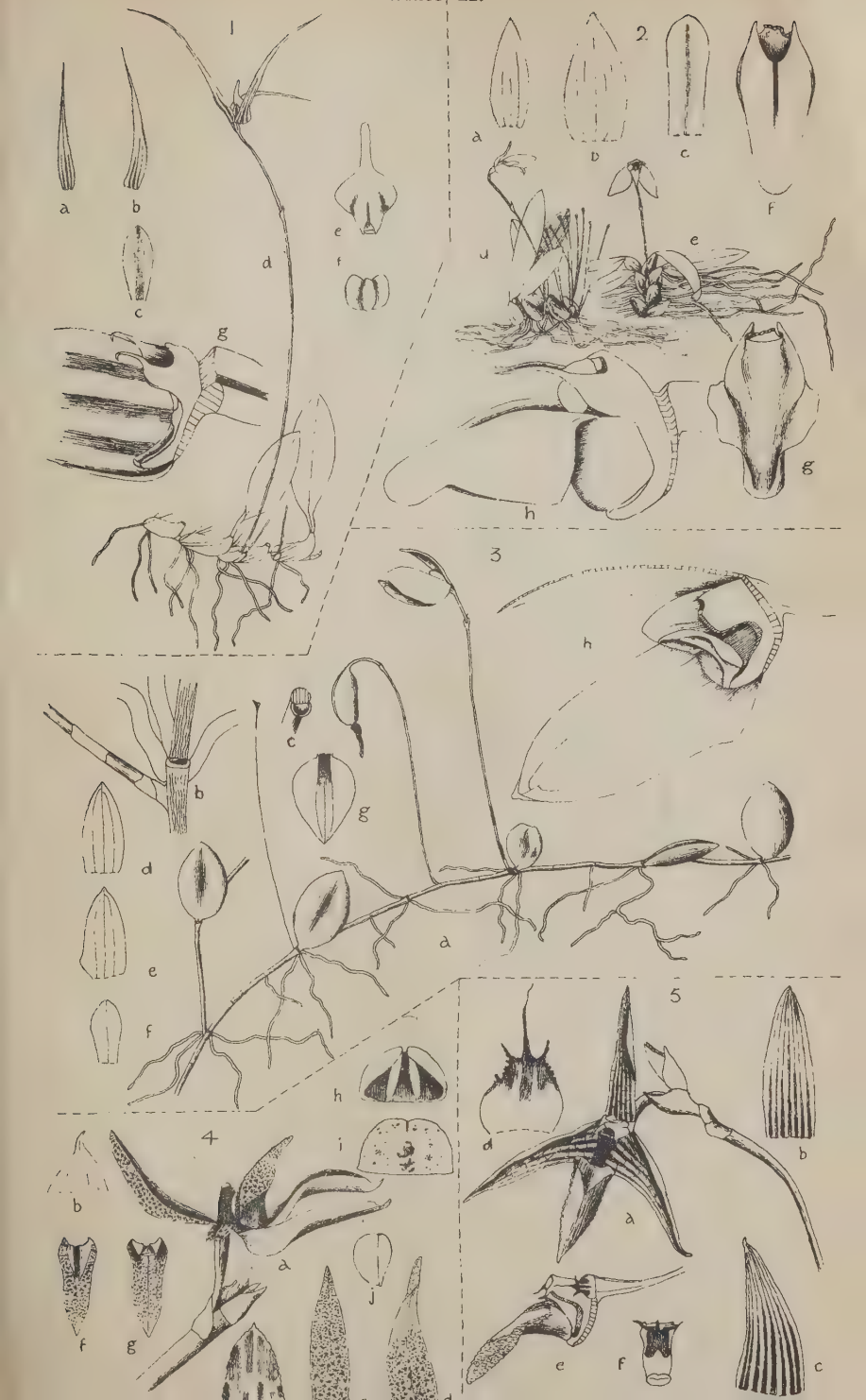
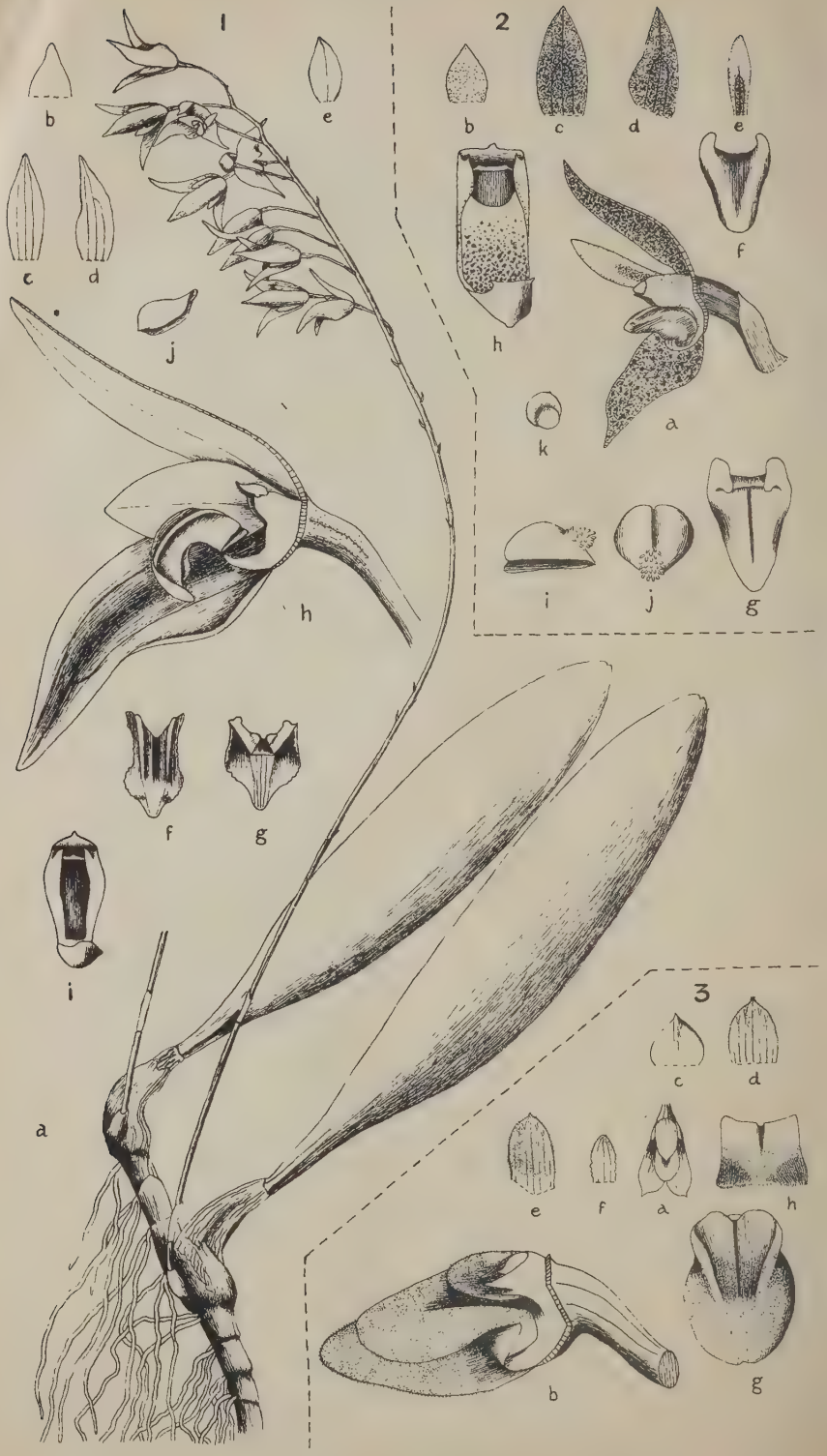


Plate III.



## PLATE III.

**Fig. 1.** Bulbophyllum tahanense, Carr.
*a*. Plant.
*b*. Bract.
*c*. Upper sepal.
*d*. Lateral sepal.
*e*. Petal.
*f*. Lip, from above.
*g*. Lip, from below.
*h*. Flower, in section.
*i*. Column, from the front.
*j*. Anther, from the side.
*a* natural size, remainder enlarged.

**Fig. 2.** Bulbophyllum foetidolens, Carr.
*a*. Flower, from the side.
*b*. Bract.
*c*. Upper sepal.
*d*. Lateral sepal.
*e*. Petal.
*f*. Lip, from above.
*g*. Lip, from below.
*h*. Column, from the front.
*i*. Anther, from the side.
*j*. Anther, from above.
*k*. 2 pollinia.
All enlarged.

**Fig. 3.** Bulbophyllum apiferum, Carr.
*a*. Flower, from above.
*b*. Flower, from the side.
*c*. Bract.
*d*. Upper sepal.
*c*. Lateral sepal.
*f*. Petal.
*g*. Lip, from above.
*h*. Anther, from above.
*a* natural size, remainder enlarged.

## PLATE IV.

**Fig. 1.** Bulbophyllum vaginulosum, Carr.
- *a.* Bract.
- *b.* Upper sepal.
- *c.* Lateral sepal.
- *d.* Petal.
- *e.* Lip, from above.
- *f.* Lip, from below.
- *g.* Flower, from the side.

All enlarged.

**Fig. 2.** Calanthe rigida, Carr.
- *a.* Upper sepal.
- *b.* Lateral sepal.
- *c.* Petal.
- *d.* Spur, from above.
- *e.* Lip, spread out.
- *f.* Lip and coumn, from the side.
- *g.* Column, from below.

*g* enlarged, remainder natural size.

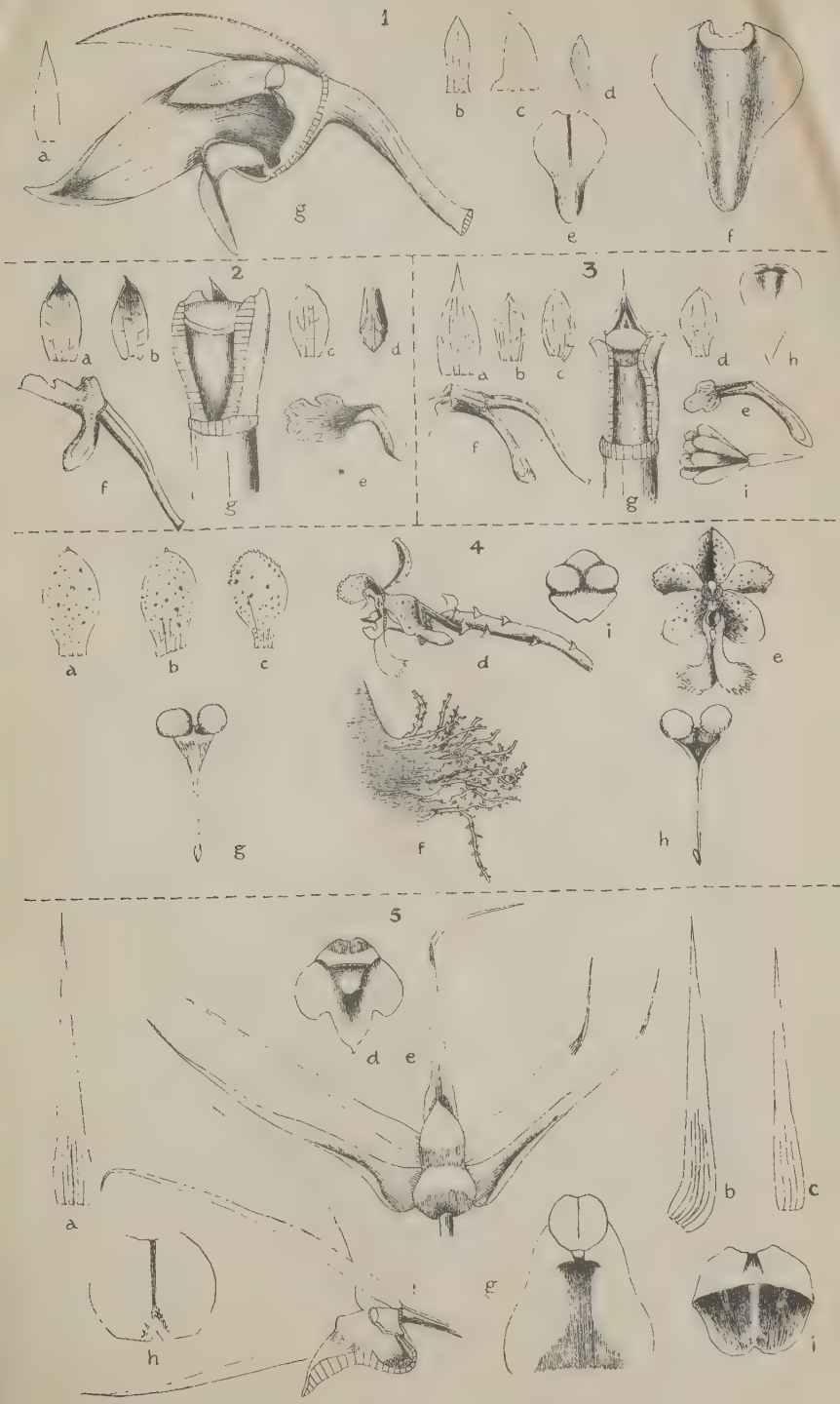
**Fig. 3.** Calanthe pusilla, Carr.
- *a.* Bract.
- *b.* Upper sepal.
- *c.* Lateral sepal.
- *d.* Petal.
- *e.* Lip, spread out.
- *f.* Lip and column, from the side.
- *g.* Column, from below.
- *h.* Anther, from above.
- *i.* Pollinia.

**Fig. 4.** Pennilabium struthio, Carr.
- *a.* Upper sepal.
- *b.* Lateral sepal.
- *c.* Petal.
- *d.* Flcwer and inflorescence, from the side.
- *e.* Flower, from the front.
- *f.* Portion of apical margin of side lobe of lip.
- *g.* Pollinia, from above.
- *h.* Pollinia, from below.
- *i.* Anther, from above.

*d* and *e* natural size, remainder enlarged.

**Fig. 5.** Thrixspermum tahanense, Carr.
- *a.* Upper sepal.
- *b.* Lateral sepal.
- *c.* Petal.
- *d.* Lip, spread out from above.
- *e.* Flower, from below.
- *f.* Flower, in section.
- *g.* Column, from below.
- *h.* Anther, from above.
- *i.* Anther, from below.

## Plate IV.



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Mohamed Haniff.

## OBITUARY.

We regret to record the sudden death on March 25th, 1930, of Mr. Mohamed Haniff, who retired on pension in 1926 after 36 years service in the Gardens Department. Mr. Haniff started work at the Waterfall Gardens, Penang, on July 1st 1890, as an apprentice, and after 3 years' apprenticeship was promoted to be Overseer. His early training under the late Mr. Charles Curtis was sound and thorough, and he retained throughout his career that devotion to and keen interest in his duties which the example of Mr. Curtis inspired. In 1910, the Waterfall Gardens were handed over to the Municipality of Georgetown, with the object of converting them into a reservoir. Mr. Haniff's services were retained by the Municipality as Overseer in charge of the Gardens, and when 15 months later the reservoir scheme was abandoned and the Gardens handed back to Government, Mr. Haniff remained in charge, under the Director in Singapore. His charge of the Gardens continued until 1921, when it was again possible to appoint a European Assistant. He was promoted to the rank of Field Assistant in 1917. In 1925 he capably deputised for the Assistant Curator of the Singapore Gardens during the latter's furlough.

In addition to his horticultural duties, he assisted in numerous field expeditions for the collection of plants and specimens in many parts of the Peninsula. He had a very extensive knowledge of the Malayan Flora, and was a keen and capable collector. His name is commemorated in *Dendrobium Haniffii*, Ridl., a beautiful species which he first collected in Kelantan in 1923.

After Mr. Haniff's retirement he continued to collect plants from time to time, and was always ready to help by supplying specimens and information. In this way he kept in close touch with the Gardens, and had actually been out to collect specimens on the day of his death. All officers of the Department mourn the loss of a friend and of a trusted colleague.

At the Botanic Gardens, Singapore, during the first half of the year 1928. Readings taken at 9 a.m. and expressed in inches.

| Date. | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| 1 | ·01 | ... | ... | 1·70 | ... | ... |
| 2 | 2·04 | 1·07 | ... | trace | ... | ... |
| 3 | 1·37 | ·16 | .. | ... | ... | ... |
| 4 | ·01 | ·06 | ... | ... | ... | ·35 |
| 5 | ·09 | trace | ... | ·92 | ... | ... |
| 6 | ·75 | ... | ... | ·08 | ·29 | ·08 |
| 7 | ·20 | 2·02 | ... | ·93 | ... | .. |
| 8 | ·03 | ... | ... | 1·68 | ·95 | trace |
| 9 | 1·00 | ... | ... | ·45 | 1·25 | ·16 |
| 10 | ·58 | ... | 1·52 | ·98 | trace | ·35 |
| 11 | ·48 | ·42 | ... | ... | ... | ... |
| 12 | 4·08 | 1·06 | ... | ·06 | ·39 | ... |
| 13 | ·02 | ... | ... | ·65 | ·02 | ·08 |
| 14 | ·76 | trace | ... | ... | trace | 1·54 |
| 15 | ... | ·50 | ·09 | 1·14 | ... | trace |
| 16 | trace | ·57 | ·02 | ·29 | ·15 | trace |
| 17 | ... | 26 | ·25 | ... | trace | trace |
| 18 | ... | ·02 | 1·29 | ... | ·20 | trace |
| 19 | ·06 | ·01 | 1·17 | 1·05 | trace | ·31 |
| 20 | ·02 | ·55 | ... | 1·32 | ... | ... |
| 21 | ·06 | trace | ·50 | ... | ... | ... |
| 22 | ·50 | ... | 1·10 | ... | ... | ... |
| 23 | ·71 | ·41 | ... | ·55 | ... | ·65 |
| 24 | ·08 | 3·02 | ... | trace | ·13 | ... |
| 25 | 1·20 | ·16 | ·16 | ... | ... | .. |
| 26 | ·15 | ... | ·01 | ... | ... | ... |
| 27 | ·01 | ... | 2·01 | ·07 | . . | ... |
| 28 | ... | 1·05 | ·12 | . . | 37 | ... |
| 29 | ... | ·15 | ·51 | ... | ·08 | ... |
| 30 | ·68 | | trace | ... | ·10 | ·18 |
| 31 | ... | | trace | | ... | |
| Total ... | 14·29 | 11·49 | 8·75 | 11·87 | 3·63 | 3·70 |

## July to Decr. 1928

At the Botanic Gardens, Singapore, during the second half of the year 1928.

Readings taken at 9 a.m. and expressed in inches.

| Date. | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | ... | ·21 | trace | ·84 | 1·11 | ... |
| 2 | trace | ... | ... | ·03 | ·67 | ·25 |
| 3 | ·09 | 1·37 | 1·23 | ·10 | 1·36 | trace |
| 4 | ... | trace | ... | ... | trace | ·07 |
| 5 | ·52 | ... | ... | ·24 | ·03 | ·78 |
| 6 | trace | ·06 | ... | trace | 1·39 | ... |
| 7 | 1·16 | ·04 | ·26 | ·38 | ... | ·90 |
| 8 | ... | ... | ·40 | ... | ·21 | ·65 |
| 9 | ... | ... | ·33 | ·36 | 2·00 | 1·51 |
| 10 | ·89 | trace | ... | ... | 1·65 | ·32 |
| 11 | 2·04 | ·65 | ... | ·06 | trace | .. |
| 12 | ·19 | ... | ·06 | ... | ·03 | trace |
| 13 | ... | ·61 | 2·56 | ... | 1·39 | ·41 |
| 14 | ... | ·09 | ·59 | ·03 | ·20 | ·17 |
| 15 | ... | trace | ·32 | ·15 | ·15 | ·26 |
| 16 | ... | ·62 | ·18 | ·18 | 1·41 | 1·25 |
| 17 | ... | ... | ... | 2·46 | 4·29 | ·71 |
| 18 | ... | ... | ... | ·41 | ·26 | trace |
| 19 | ... | ·30 | ... | ·13 | ·18 | ... |
| 20 | ... | 1·11 | trace | 1·04 | ·59 | ... |
| 21 | ... | ... | ·48 | ·15 | trace | ·03 |
| 22 | ... | trace | 1·62 | ... | ... | ·47 |
| 23 | ... | ... | ... | ·31 | ... | ·22 |
| 24 | ... | 1·75 | 1·14 | trace | ·13 | trace |
| 25 | ... | 1·25 | ... | trace | ·19 | ·01 |
| 26 | ... | ·72 | ... | ·61 | ... | ·17 |
| 27 | ... | ·15 | ·02 | trace | ... | trace |
| 28 | ·12 | trace | ... | ... | ... | 1·44 |
| 29 | ... | 1·42 | ... | ... | ·44 | ·23 |
| 30 | ... | ... | .61 | ... | ... | ... |
| 31 | 2·32 | ·39 | | ... | | ·43 |
| Total ... | 7·33 | 10·74 | 9·80 | 7·48 | 17·68 | 10·28 |

## Rainfall
## Jan. to June 1928

At the head of the Waterfall Gardens, Penang during the first half of the year 1928, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Water Engineer, Penang.

| Date | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| 1 | ·32 | ... | ... | ·30 | ·12 | ... |
| 2 | ·74 | ... | ... | ·03 | 2·70 | ... |
| 3 | ... | ·10 | ... | ... | ·06 | ... |
| 4 | ·29 | ... | ... | ·65 | ·26 | ·04 |
| 5 | ·70 | ... | ... | ·05 | ·60 | ... |
| 6 | ... | ... | ... | ... | ·29 | ... |
| 7 | ... | ... | ... | ·15 | ·98 | ... |
| 8 | ... | ... | ... | ·30 | 2·22 | .. |
| 9 | ... | ... | ... | ·03 | ·03 | ... |
| 10 | ... | ... | ·14 | ·23 | ·56 | . . |
| 11 | ... | ... | ·04 | ·86 | 1·33 | ... |
| 12 | ·21 | ... | ... | ·65 | 1·79 | ... |
| 13 | . | ·22 | ... | ·04 | ... | ·38 |
| 14 | ... | ·25 | ... | ·22 | ·85 | 1·58 |
| 15 | ... | ... | .. | ·32 | ... | ... |
| 16 | ... | 1.36 | ·07 | ·42 | ·39 | ... |
| 17 | ... | ·03 | ·04 | 4·09 | ·36 | ... |
| 18 | ... | ·37 | ·12 | 2·20 | ·11 | ... |
| 19 | ... | ... | ·12 | ·29 | ... | ... |
| 20 | .. | ... | ·33 | ·77 | ·29 | ... |
| 21 | ... | ·18 | ·05 | ·47 | ·10 | 3·48 |
| 22 | 1·12 | ... | ... | ·09 | ·30 | ... |
| 23 | ·38 | ... | ·11 | ·03 | ·55 | ·14 |
| 24 | ... | ... | ·13 | ·13 | ·91 | ... |
| 25 | ... | ... | 1·82 | ... | ... | ... |
| 26 | ... | ... | ·55 | ... | ... | ... |
| 27 | . . | ... | ... | ·55 | ... | ... |
| 28 | ... | ... | 1·93 | ·88 | ... | ·26 |
| 29 | ... | ... | ... | ... | 1·80 | ·03 |
| 30 | ... | | ·31 | ·89 | 2·29 | 39 |
| 31 | ... | . | ·22 | | ·09 | |
| Total ... | 3·76 | 2·51 | 5·98 | 14·64 | 18·98 | 6·30 |

## July to Decr. 1928

At the head of the Waterfall Gardens, Penang during the second half of the year 1928, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Water Engineer, Penang.

| Date | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | ·39 | ·80 | ... | ·03 | ... | ·39 |
| 2 | ·50 | ·02 | ... | ·56 | ·05 | ·03 |
| 3 | ... | 2·32 | ... | ·39 | ... | ... |
| 4 | ·70 | ·03 | ·03 | ·54 | ·08 | ·13 |
| 5 | ... | ·03 | 1·76 | 2·24 | ·39 | ·03 |
| 6 | ... | 1·87 | 2·62 | ·08 | ·11 | ... |
| 7 | ... | ·05 | 2·75 | ·28 | ·33 | ·39 |
| 8 | ... | ... | 2·61 | ·79 | ·77 | ·13 |
| 9 | ·80 | ·13 | 2·73 | ·05 | ·25 | ·32 |
| 10 | ·06 | ... | 4·94 | ·26 | ·03 | ·26 |
| 11 | ·14 | ·34 | 1·85 | ·09 | ·08 | ·12 |
| 12 | ... | ... | ·41 | 1·91 | ·73 | ·05 |
| 13 | ... | ·04 | 1·60 | ·33 | ·03 | ... |
| 14 | ... | 1·14 | 3·12 | ·21 | ·25 | ·21 |
| 15 | ... | .. | ·03 | ·20 | ·38 | ·04 |
| 16 | ... | 3·35 | ·10 | ·13 | ... | ·03 |
| 17 | ... | 1·70 | ·03 | ·12 | ·07 | ·46 |
| 18 | ·06 | ·04 | ·11 | ·23 | ·18 | ·72 |
| 19 | ·03 | .. | ·07 | ·70 | ·27 | ... |
| 20 | ... | ·09 | 1·17 | ... | ... | ... |
| 21 | ... | ·02 | ·03 | ·03 | 2·46 | ·66 |
| 22 | ... | ·37 | ... | ... | ... | ... |
| 23 | ... | ·23 | ·19 | ·27 | ·03 | ·07 |
| 24 | ... | ·43 | ... | ·21 | ... | ... |
| 25 | ... | 1·23 | ·03 | ·10 | ... | ·11 |
| 26 | ·49 | ·09 | ·18 | ... | ... | 1·67 |
| 27 | ·73 | ·15 | ... | ... | ·26 | ·04 |
| 28 | ·30 | ·17 | ... | ... | ... | ·22 |
| 29 | ·38 | ... | ... | 1·92 | .. | ·05 |
| 30 | ·12 | ·07 | 2·96 | ·98 | ... | ... |
| 31 | 27 | ·39 | | ·23 | | ... |
| Total ... | 4·97 | 15·10 | 29·32 | 12·88 | 6.75 | 6·13 |

At the Botanic Gardens, Singapore, during the first half of the year 1929. Reading taken at 9 a.m. and expressed in inches.

| Date | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| 1 | ·96 | ·65 | Nil | ·06 | trace | ·09 |
| 2 | ·68 | 1·70 | ... | ·77 | Nil | Nil |
| 3 | trace | Nil | ... | Nil | ·16 | ... |
| 4 | ... | ·14 | ... | ·06 | trace | ... |
| 5 | 2·48 | ·33 | ... | Nil | 2·85 | ·73 |
| 6 | ·30 | ·29 | ... | ... | ·21 | ·03 |
| 7 | trace | Nil | ... | ... | trace | ·09 |
| 8 | Nil | ·08 | ... | ... | ·16 | ·30 |
| 9 | ... | Nil | ... | trace | Nil | Nil |
| 10 | .. | ... | 1·95 | Nil | ... | ·37 |
| 11 | ... | 1·67 | ·20 | ... | trace | trace |
| 12 | ·15 | ·05 | ·13 | ·62 | ·56 | ·02 |
| 13 | Nil | ·25 | ·11 | Nil | ·27 | Nil |
| 14 | ·10 | trace | ·20 | ·01 | ·34 | ... |
| 15 | Nil | ·91 | ·21 | ·01 | Nil | ... |
| 16 | ·16 | trace | Nil | Nil | ... | ·22 |
| 17 | ·16 | ·13 | ·01 | ·02 | ... | Nil |
| 18 | Nil | ·14 | ·03 | Nil | ... | ... |
| 19 | ... | trace | ·68 | ·09 | ... | ·73 |
| 20 | ... | Nil | ·18 | ·10 | 1·26 | Nil |
| 21 | ... | ·94 | Nil | trace | Nil | trace |
| 22 | ·23 | Nil | ... | Nil | ... | Nil |
| 23 | Nil | ... | ... | ... | .. | ... |
| 24 | ... | ·67 | ... | ·34 | ·07 | ·45 |
| 25 | ... | Nil | ·81 | Nil | Nil | 1·72 |
| 26 | ... | ·57 | 1·96 | ·14 | ·92 | ·82 |
| 27 | ... | ·47 | ·57 | Nil | ·28 | Nil |
| 28 | ... | Nil | ·04 | ... | ·22 | 2·52 |
| 29 | ... | | Nil | ·29 | ·13 | ·02 |
| 30 | ... | | ... | Nil | Nil | Nil |
| 31 | ... | | 1·98 | | 1·24 | |
| Total.. | 5·22 | 8·99 | 9·06 | 2·51 | 8·67 | 8·11 |

**July to Decr. 1929**

At the Botanic, Gardens, Singapore, during the second half of the year 1929.
Reading taken at 9 a.m. and expressed in inches.

| Date | July | Aug. | Sept. | Oct. | Nov | Dec. |
|---|---|---|---|---|---|---|
| 1 | Nil | Nil | ·10 | trace | ·46 | ·14 |
| 2 | ... | ... | Nil | Nil | trace | ·45 |
| 3 | ... | ... | ... | ... | Nil | ·23 |
| 4 | ... | ... | ·07 | ·10 | ... | ·04 |
| 5 | ... | ... | ·64 | Nil | ... | ·27 |
| 6 | ... | ... | ·11 | 1·30 | ·49 | ·01 |
| 7 | ... | ... | ·05 | ·15 | Nil | ·08 |
| 8 | ... | ... | Nil | Nil | ·01 | ·11 |
| 9 | ... | ... | ... | ·30 | ·12 | Nil |
| 10 | ... | ·20 | ·05 | ·19 | 2·30 | ... |
| 11 | ... | 1·61 | trace | ·67 | ·06 | ... |
| 12 | ... | 1·31 | ·70 | Nil | ·14 | .. |
| 13 | ·28 | Nil | Nil | ·08 | ·27 | trace |
| 14 | Nil | trace | ·11 | trace | 2·56 | Nil |
| 15 | ·31 | ·07 | Nil | ·03 | ·14 | ... |
| 16 | 64 | Nil | ·50 | Nil | ·01 | ·29 |
| 17 | Nil | ... | ·21 | ... | Nil | ·56 |
| 18 | ... | ... | Nil | ... | 1·65 | trace |
| 19 | ·08 | ... | ... | ·52 | ·33 | Nil |
| 20 | ·09 | trace | ·05 | ·24 | Nil | ·56 |
| 21 | ·12 | Nil | Nil | Nil | ·46 | ·23 |
| 22 | Nil | ... | ... | ·19 | Nil | ·11 |
| 23 | trace | ... | ·02 | ·06 | ·06 | trace |
| 24 | trace | ·37 | Nil | trace | Nil | Nil |
| 25 | ·63 | ·34 | ... | 2·08 | trace | ... |
| 26 | Nil | trace | ·05 | Nil | ·51 | ·02 |
| 27 | ... | ·09 | Nil | ·10 | Nil | Nil |
| 28 | ... | Nil | ·13 | 1·56 | ... | ·92 |
| 29 | ... | ·07 | 5·80 | ·25 | 1·96 | Nil |
| 30 | .. | 1·93 | ·45 | ·18 | ·08 | ·31 |
| 31 | ... | 1·98 | | ·33 | | ·16 |
| Total... | 2·15 | 7·97 | 9·04 | 8·23 | 11·61 | 4·49 |

## Jan. to June 1929

At the head of the Waterfall Gardens, Penang during the first half of the year, 1929, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

| Date | Jan. | Feb. | March | April | May | June |
|---|---|---|---|---|---|---|
| 1 | Nil | Nil | Nil | ·26 | ·05 | Nil |
| 2 | ·38 | ... | ... | Nil | Nil | ... |
| 3 | Nil | ... | ... | ... | ·87 | ·29 |
| 4 | ... | ... | ... | ... | .67 | Nil |
| 5 | ... | ... | ·38 | ... | ·03 | ... |
| 6 | ... | ... | Nil | ... | ·04 | ... |
| 7 | ... | ... | ... | ·06 | ·02 | ·24 |
| 8 | ... | ... | ... | ... | Nil | Nil |
| 9 | ... | ... | ... | .. | ... | ... |
| 10 | ... | 2·42 | ... | ·14 | ·52 | ·04 |
| 11 | ... | ·05 | ·40 | Nil | ·18 | ·68 |
| 12 | ... | 1·12 | ·28 | ·08 | Nil | ·42 |
| 13 | ... | Nil | 2·02 | ·11 | ... | Nil |
| 14 | ... | ·03 | ·32 | Nil | ... | ... |
| 15 | ... | ·94 | ·23 | .02 | ·08 | 1·03 |
| 16 | ... | Nil | ·18 | ·17 | ·19 | 2·25 |
| 17 | ... | ... | Nil | Nil | ·04 | ·44 |
| 18 | ... | ... | ·48 | ·07 | ·07 | Nil |
| 19 | ... | ·07 | Nil | .03 | ·13 | ·85 |
| 20 | ... | ·57 | ... | 2·28 | ·12 | ·09 |
| 21 | ... | 1·51 | ... | ·10 | ·02 | Nil |
| 22 | ... | ·53 | ·17 | ·03 | ·03 | ·43 |
| 23 | ... | ·08 | Nil | ·41 | ·08 | Nil |
| 24 | ... | ·30 | ... | ·42 | ·03 | ... |
| 25 | ... | ·42 | ·09 | 1·46 | Nil | ·83 |
| 26 | .. | Nil | ·39 | Nil | ·11 | ·21 |
| 27 | ... | .. | ·23 | ... | ·73 | ·69 |
| 28 | ... | ... | ·13 | ·06 | 2·44 | ·03 |
| 29 | ... | | ·59 | ·60 | ·03 | ... |
| 30 | ... | | ·09 | 4·60 | Nil | ... |
| 31 | ... | | ·73 | | ·02 | |
| Total ... | ·38 | 8·04 | 6·71 | 10·90 | 6·50 | 8·52 |

## July to Decr. 1929

At the head of the Waterfall Gardens, Penang during the seeond half of the year, 1929, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

| Date | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | Nil | ·40 | 1·25 | Nil | ·12 | ·59 |
| 2 | ... | 1·22 | Nil | ·13 | .54 | Nil |
| 3 | ... | Nil | ·26 | ·15 | ·05 | ... |
| 4 | ... | ... | 4·35 | Nil | 1·04 | ... |
| 5 | ... | ... | 1·37 | ·93 | ·03 | ... |
| 6 | ... | ·62 | ·04 | 1·7. | ·05 | ... |
| 7 | 1·93 | Nil | Nil | ·72 | ·54 | ... |
| 8 | ·03 | 1·62 | 1·36 | ·16 | 1·73 | ... |
| 9 | ·10 | ·59 | ·06 | ·04 | ·87 | ... |
| 10 | Nil | 3·17 | ·95 | Nil | 2·28 | ... |
| 11 | ... | Nil | ·50 | ·05 | ·04 | .. |
| 12 | ... | ... | ·57 | ·82 | ·29 | ... |
| 13 | ... | 1·10 | ·30 | ·02 | ·07 | ... |
| 14 | ·47 | ·09 | ·20 | ·77 | ·03 | 1·04 |
| 15 | .. | Nil | ·22 | Nil | ·33 | ·60 |
| 16 | ... | ·04 | ·35 | ·41 | ·15 | ·98 |
| 17 | ·25 | Nil | ·06 | Nil | ·04 | ·03 |
| 18 | ·30 | ... | ·27 | ·26 | 3·93 | Nil |
| 19 | Nil | ... | ·22 | Nil | Nil | .. |
| 20 | ... | ... | ·05 | ... | ·55 | ... |
| 21 | ... | ... | ·08 | ... | ·05 | ... |
| 22 | ... | ... | ·45 | ·03 | ·14 | ... |
| 23 | ·04 | ... | ·19 | ·43 | Nil | ... |
| 24 | Nil | ... | ·14 | Nil | ·25 | ·04 |
| 25 | ... | ·57 | ·22 | ... | ·72 | ... |
| 26 | ·32 | ·06 | ·21 | ·12 | ·06 | ... |
| 27 | Nil | Nil | ·84 | ·30 | ·04 | ... |
| 28 | ... | ·80 | 3·11 | ·16 | ·04 | ... |
| 29 | ... | ·45 | ·15 | ·20 | ·05 | ... |
| 30 | ... | ·02 | Nil | ·12 | ·42 | ... |
| 31 | ... | ·36 | | ·02 | | ·35 |
| Total ... | 3·44 | 11·11 | 17·77 | 7.59 | 14·45 | 3·63 |

## Summary of Rainfall 1928.

| | Singapore. | | | | Penang. | | | |
|---|---|---|---|---|---|---|---|---|
| | No. of rainy days | Amount of Rain. | | Longest spell without rain. | No. of rainy days. | Amount of Rain. | | Longest spell without rain. |
| | | Inches. | mm | | | Inches. | mm | |
| Jan. | 25 | 14·29 | 363 | 2 days | 7 | 3·76 | 95 | 9 days |
| Feb. | 20 | 11·49 | 292 | 3 „ | 7 | 2·51 | 63 | 17 „ |
| Mar. | 15 | 8·75 | 223 | 9 „ | 15 | 5·98 | 152 | |
| April | 17 | 11·87 | 301 | 3 „ | 25 | 14·64 | 372 | 2 „ |
| May | 15 | 3·63 | 92 | 5 „ | 24 | 18·98 | 482 | 4 „ |
| June | 14 | 3·70 | 94 | 6 „ | 8 | 6·30 | 160 | 8 „ |
| July | 10 | 7·33 | 186 | 16 „ | 14 | 4·97 | 126 | 6 „ |
| Aug. | 21 | 10·74 | 273 | 2 „ | 25 | 15·10 | 383 | 1 day |
| Sep. | 17 | 9·80 | 249 | 3 „ | 22 | 29·32 | 745 | 3 days |
| Oct. | 21 | 7·48 | 190 | 4 „ | 26 | 12·83 | 327 | 3 „ |
| Nov. | 23 | 17·68 | 449 | 3 „ | 19 | 6·75 | 171 | 3 „ |
| Dec. | 25 | 10·28 | 261 | 2 „ | 22 | 6·13 | 155 | 2 „ |
| Total. | 223 | 117·04 | 2973 | | 214 | 127·32 | 3231 | |

| | |
|---|---|
| Greatest amount in 24 hours 4·29″ or 109 mm. | 4·94 inches or 126 mm. |
| Greatest amount in 48 hours 5·70″ or 145 mm. | 7·67 inches or 195 mm. |
| Greatest amount in 72 hours 5·96″ or 151 mm. | 10·28 inches or 261 mm. |
| Periods in which more than 5 ins. fell in 72 hours. 2 (Jan. Nov.) | 3 (April, September). |
| Periods in which less than ·02 ins. fell in 120 hours. 6 (Mar., Apr.-May, May, June, July, October.) | 10 (Jan., Feb., Mar., June, July). |

## Summary of Rainfall 1929.

| | Singapore. | | | | Penang. | | | |
|---|---|---|---|---|---|---|---|---|
| | No. of rainy days | Amount of Rain. Inches. | Amount of Rain. mm | Longest spell without rain. | No. of rainy days | Amount of Rain. Inches. | Amount of Rain. mm | Longest spell without rain. |
| Jan. | 12 | 5·22 | 132 | 9 days | 1 | ·38 | 9 | 29 days |
| Feb. | 19 | 8·99 | 229 | 10 „ | 12 | 8·04 | 204 | 9 „ |
| Mar. | 15 | 9·06 | 230 | | 16 | 6·71 | 170 | 5 „ |
| April | 14 | 2·51 | 64 | 4 „ | 17 | 10·90 | 277 | 5 „ |
| May | 18 | 8·67 | 220 | 5 „ | 23 | 6·50 | 165 | 3 „ |
| June | 16 | 8·11 | 206 | 13 „ | 15 | 8·52 | 216 | 3 „ |
| July | 9 | 2·15 | 54 | | 8 | 3·44 | 88 | 6 „ |
| Aug. | 13 | 7·97 | 202 | 15 „ | 15 | 11·11 | 282 | 8 „ |
| Sep. | 17 | 9·04 | 230 | 2 „ | 27 | 17·77 | 452 | 2 „ |
| Oct. | 21 | 8·23 | 209 | 3 „ | 21 | 7·59 | 193 | 3 „ |
| Nov. | 20 | 11·61 | 295 | 3 „ | 28 | 14·45 | 367 | 1 „ |
| Dec. | 20 | 4·49 | 114 | 4 „ | 7 | 3·63 | 92 | 12 „ |
| Total. | 194 | 86·05 | 2184 | | 190 | 99·04 | 2515 | |

| | |
|---|---|
| Greatest amount in 24 hours 5·80″ or 147 mm. | 4·60 inches or 117 mm. |
| Greatest amount in 48 hours 6·23″ or 159 mm. | 5·72 inches or 146 mm. |
| Greatest amount in 72 hours 6·38″ or 162 mm. | 5·98 inches or 152 mm. |
| Periods in which more than 5 ins. fell in 72 hours. 1 (Sept.) | 3 (April, August, September). |
| Periods in which less than ·02 ins. fell in 120 hours. 10 (Jan., Mar., Apr., May., July, Aug., Dec.) | 10 (Jan., Feb., Mar., Apr., July, Aug., Dec.) |